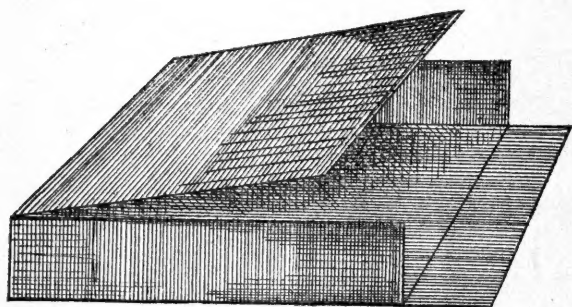
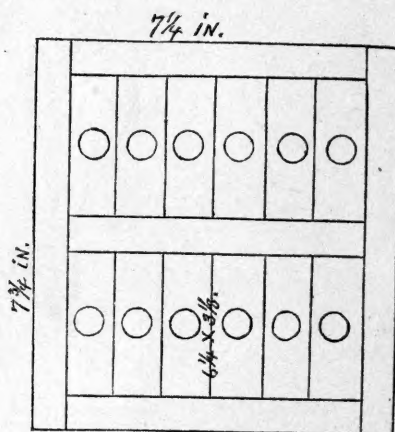


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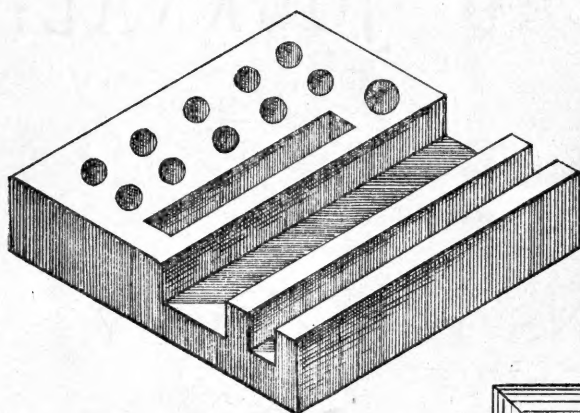
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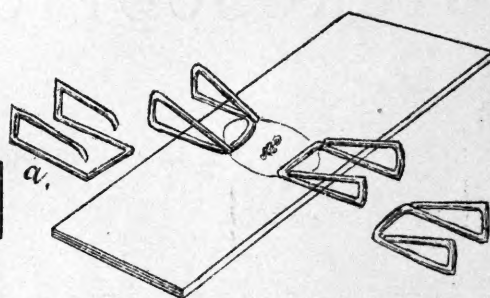
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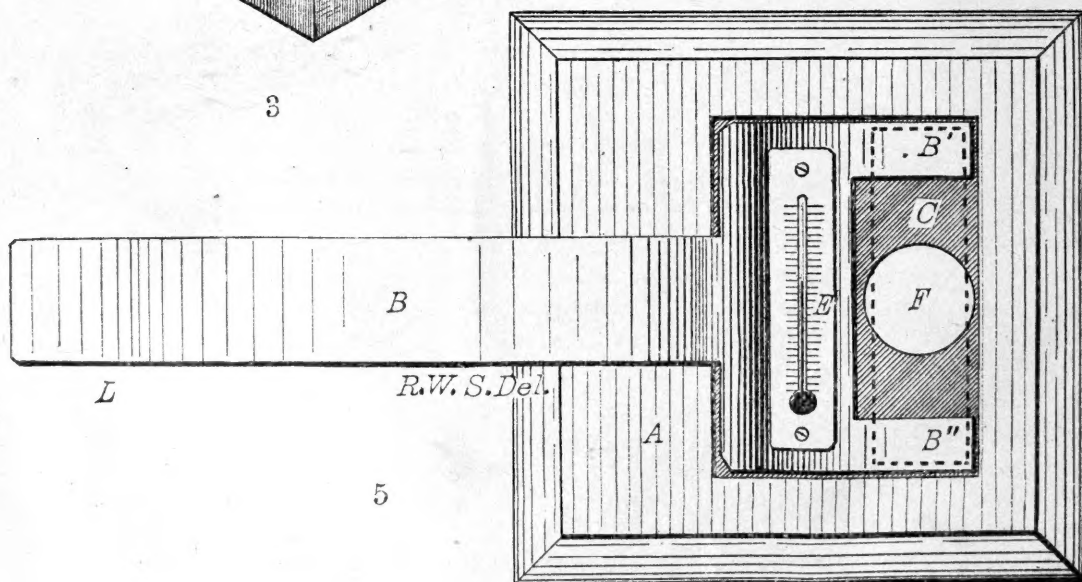
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SOME INEXPENSIVE APPARATUS.

(THE) AMERICAN
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MONTHLY

MICROSCOPICAL JOURNAL:



(CONTAINING

CONTRIBUTIONS TO BIOLOGY.)

VOLUME XI.

FOR

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THE AMERICAN MONTHLY MICROSCOPICAL JOURNAL.

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JANUARY, 1890.

No. 1.

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An Easily Constructed Hot-Stage.

By ROBERT W. SMILEY,

WASHINGTON, D. C.

A very simple and convenient hot-stage was exhibited by Dr. Robert Reyburn at a recent meeting of the Washington Microscopical Society. This form is adapted from the more complicated and expensive forms used by microscopists, and is especially useful from the fact that it can be made at a trifling cost by any one possessing a little mechanical skill. In the frontispiece, figure 5, A represents the wooden block or stage, which is fastened upon the brass stage of the microscope. A space is cut from the upper surface of this block, as shown by C, into which is fitted a piece of copper plate (B, B', B''). A round hole is also cut at F, the opening of the brass stage, to allow illumination of the object to be examined. The slide is placed on the copper bed with its ends resting at B' and B'', as indicated by the dotted lines. The heat is applied by a spirit lamp at the end (L) of the copper plate (B) which gradually transmits the heat by conduction to the slide. The temperature is registered by the thermometer (E), which is screwed fast to the copper plate.

The importance of the use of a hot-stage in the examination of many preparations is obvious. It is often desirable to keep objects at a given temperature or to raise them above the surrounding atmosphere in order that the effect of heat upon reagents and upon the vitality of living micro-organisms may be observed. This form will be found to answer the purpose admirably for nearly all occasions that may demand the use of a hot-stage.

EXPLANATION OF PLATE.

FIG. 1. Hamilton's slide box.

FIG. 2. Hamilton's slide tray.

FIG. 3. Pillsbury's reagent block.

FIG. 4. Bryan's mounting clips.

FIG. 5. An easily constructed hot-stage.

A Cheap Box for Slides.*

By W. P. HAMILTON,

SHREWSBURY, ENGLAND.

The slide cases sold by dealers being often expensive, many persons will prefer the one shown in the frontispiece, Figures 1 and 2.

Make a pine box, of which the inside measurements are $7\frac{1}{2}$ by 8, and 3 in. deep. If deeper, the box becomes too large to grasp comfortably in the hand. The lid should hinge on one of the $7\frac{1}{2}$ in. sides, and the opposite side of the box should let down flat by means of a pair of hinges at the bottom. Cut a number of squares of cardboard for trays, $7\frac{3}{4}$ by $7\frac{3}{4}$. Then for each tray cut two half-inch strips of stoutest pasteboard, $7\frac{3}{4}$ in. long; three strips of the same width, $6\frac{1}{4}$ in. long. With glue or thick gum affix the two long and two of the short strips to the cardboard close to the edge, and use the remaining short piece to divide the central space equally into two. The size of the spaces will be $6\frac{1}{2}$ by $3\frac{1}{8}$, and each tray will hold a dozen slides. My own box, 3 in. deep, holds 24 of these trays, capable of accommodating 288 slides, and the cost of the whole is a little over one dollar, or less than one-fifth for the same amount of accommodation in boxes sold for the purpose.

The cardboard and pasteboard must be cut with a knife, not with scissors; if gum is used it must be well dissolved, strained, and very thick, and each tray as it is made must be placed under a weight, one on the top of another. If the thickness of the pasteboard is not enough to furnish depth for the slides containing objects mounted in raised cells, it can be increased by adding a thickness of cardboard, or even another of pasteboard.

An Inexpensive Reagent Block.

By PROF. J. H. PILLSBURY,

NORTHAMPTON, MASS.

A frequently expressed need of some convenient and inexpensive block or case in which to place the reagents and apparatus used in the biological laboratories, leads me to describe the form I have used for some time. (Frontispiece, figure 3.)

It is a plain whitewood block, 15 c. m. square and 4 c. m. thick. On the upper side of this three grooves are cut, each 15 c. m. deep. The first is 1 c. m. from the edge and 1 c. m. wide. The second is 1 c. m. from it and 3.5 c. m. wide. The third is 1 c. m. from it and 2 c. m. wide. Into one end there is glued a closely-fitted block 1 c. m. long, and in the other end one 5 c. m. long, leaving a trough for slides about 90 c. m. long. In the place where these last blocks is glued is bored a hole 1.5 c. m. in diameter and 1 c. m. deep, into which tightly fits a paper pill box for covers. The remainder of the block is provided with two rows of 5 holes, each 2 c. m. in diameter and 3.5 c. m. deep, for reagent phials. The first groove is used for razor, and the second for pencils, pipette, forceps, etc. The block is easily made; costs very little; is very neat in appearance, and convenient in work.

* *Science Gossip*, Nov., 1889, p. 244.

A New Form of Mounting Clip.*

By G. H. BRYAN.

There are, I suppose, few microscopists who have not tried the use of various forms of spring clips for mounting in Canada balsam, and who have abandoned them because they do more harm than good. The pressure produced by the ordinary clip being far from uniform, some mounters have invented spring-clip boards or arrangements in which the pressure is produced by weight. But all of these possess this disadvantage, that delicate objects are ruined by the pressure, while those that are more elastic will lift the cover up as soon as the pressure is removed, thereby admitting air. In order to keep the cover in position while the balsam is "setting" without producing pressure, I devised, early in 1887, the clips shown in the frontispiece, figure 4, to which I give the name of "Pressureless Edge Clips." Their use will be obvious from the figure. Two are required for each slide, and their points are brought to bear against the edge, not on the top of the cover, which is thus held fixed. They are made of brass wire, of different sizes according to the size of the cover; the form marked *a* is especially useful for thick objects. When applied to newly-mounted balsam slides, a great deal of the superfluous balsam may be scraped from round the edges without shifting the cover, and the slide then "baked" on a hot water cistern or elsewhere for a week or more, and there being no pressure, there is no danger of "springing" when the clips are removed. I now find the clips invaluable, and several friends have also adopted them.

Use of Eye-Piece Micrometers and other Eye-Piece Accessories.

By E. J. JONES,

VICE-PRESIDENT OF THE CALCUTTA MICROSCOPICAL SOCIETY.

The eye-piece micrometer is more generally applicable in measuring than the stage micrometer, for while the latter can be used directly only with very low powers, the former can be directly used in all cases. The stage micrometer can, by the help of the camera lucida, be used indirectly for measuring even with high powers.

There are several forms of this micrometer. The simplest consists of a glass disc cut so as to fit into the eye-piece, resting on the diaphragm, at the focus of the upper glass of the eye-piece. On this glass there are ruled two series of fine lines at right angles to each other, and at equal distances, so as to form squares. It is quite immaterial what the distance between the lines is, so long as they are all equal, and not too wide apart. The most convenient distance is from 1-25"-1-100", though the closer they are together the more chance there is of the lines nearly or quite coinciding with the edges of the objects to be measured; less error is thus introduced in the computation of the fractions of an interval. In order to use this micrometer, it is necessary to obtain an accurately divided stage micrometer, with which

**Science Gossip*, December, 1889, p. 271.

to determine the value of the intervals between the lines with each objective which it is intended to use with the eye-piece. This operation having been performed, the stage micrometer can then be dispensed with.

In order to make this determination, a stage micrometer ruled to, say 1-100" and 1-1000", is laid upon the stage of the microscope and brought into focus. The lines of the stage micrometer are now brought parallel to one of the series in the eye-piece, and one of the lines of this series made to coincide with one of the lines of the stage micrometer by shifting the latter till the desired position is arrived at. It must now be observed how many of the divisions of the stage micrometer correspond to one division of the eye-piece micrometer, and it is well to pull out the draw-tube till some simple relation is arrived at. Thus, supposing we have taken a stage micrometer divided into 1-100" and 1-1000", and we find that one of the larger divisions of the stage micrometer (equal to 1-100") corresponds to $9\frac{1}{2}$ divisions of our ruled glass disc in the eye-piece, we should pull out the draw-tube till it corresponded exactly to ten divisions, and each division would now correspond to one of the smaller divisions of the stage micrometer, or 1-1000". The distance to which it is necessary to pull out the draw-tube must then be noted down for future reference, as also the fraction of an inch corresponding to each division of the eye-piece micrometer.

This operation must naturally be repeated for each objective. It is well to perform the operation several times with each objective, using different portions of the two micrometers, and taking the mean of the results, as, although lines can now be ruled on glass at very close intervals with a high degree of accuracy, it is always well to correct, as far as possible, any slight error there may be in the ruling of the lines on your micrometer, or arising from errors of observation. It is also necessary, when using these objectives which are provided with the means of adjustment to the thickness of the glass that covers the object, to make an allowance for this, since the magnifying power is considerably affected by the separation of the lenses. It will be found convenient to compensate for this alteration by altering the draw-tube in such a manner as to neutralize the effect produced by the adjustment of the objective, thus giving one uniform value to the divisions of the eye-piece, whatever may be the thickness of the cover-glass.

The amount of alteration must, of course, be determined by a series of measurements with the stage micrometer, and noted at the time.

Suppose now we have, on the stage of the microscope, any object which it is desirable to measure, and are using an objective with which it has been found that one division of the eye-piece micrometer = 1-1000", the draw-tube being pulled out to the proper distance, as noted at the time when the determination of the values of the eye-piece micrometer divisions was made, the object is brought into such a position that one of its edges seems to touch one of the lines of the micrometer, while the diameter which is to be measured lies at right angles to the micrometer lines. It is then observed where the opposite edge falls, and what is the number of divisions between the two along the diameter. Suppose the object occupies $5\frac{1}{2}$ divisions of the micrometer; it will then measure $5\frac{1}{2}$ -1000" or 0.0055".

The next simplest form of micrometer consists of a transparent glass scale, which is introduced through a couple of slots in the eye-piece,

at the focus of the eye-glass. It is ruled like an ordinary measure on a slip of glass, with every 10th line long and every 5th line longer than the others, but shorter than the 10th lines. The actual size of the divisions is, of course, immaterial, but their value must be determined by means of the stage micrometer. The scale is brought to bear on the object to be measured, by moving the latter into the centre of the field, and rotating the eye-piece till the divisions of the scale lie at right angles to the diameter to be measured. The micrometer is then shifted till one of the longer lines coincides with one end of the object, and the number of divisions between this point and the opposite edge read off. The scale may be made more delicate by the application of the diagonal scale introduced by Hartnack. In this form, the vertical lines are crossed by two parallel lines at a distance from each other of five divisions of the scale, and the parallelogram thus formed is crossed by a diagonal. The lengths of the lower segments of the 50 vertical lines cut off by the diagonal, thus increase progressively from 0.1 to 5.0, so that, when it is desired to obtain an exact measurement of an object between these limits, it is only necessary to find the segment whose length coincides with the diameter to be measured, which it will give in 1-10s of the value of the smaller divisions, whatever these may be. Thus, suppose the length of the segment is 2.6. If each of these smaller divisions represent 1-1000", then the length of this segment corresponds to 2.6-1000" or 0.0026".

Owing to the difficulty of accurately adjusting the lines of the eye-piece micrometer to those of the stage micrometer, or the edges of objects, while observing under high powers, Jackson introduced a form in which this difficulty is to a great extent obviated. It consists of the same scale as the last described, but the ruled glass is set in a brass frame in which it can slide endways, the motion being communicated by means of a screw working against one end of the glass, while the other end is supported by a spring.

The brass frame being inserted into the eye-piece through the slits, and roughly adjusted by hand, the final adjustment can be readily and quickly made by working the scale backwards or forwards by means of the screw till it is in the required position.

Ramsden's micrometer is a more complicated but at the same time more accurate instrument. It consists essentially of two fine parallel wires or spider threads, stretched across the field of the eye-piece, one of which can be caused to approach and recede from the other by means of a micrometer screw with a graduated head.

A portion of the field of view on one side is cut off at right angles to the filaments, by a scale formed of a thin plate of brass, notched along the edge. Each notch is equivalent to one complete turn of the screw, and every fifth notch is made deeper than the others, so that the number of complete revolutions of the screw can be read off without taking the eye from the object.

The value of the divisions of this micrometer must, of course, be determined, as usual, by means of an accurately ruled stage micrometer. The object to be measured is brought into such a position that one of its edges coincides with the stationary filament; the other thread is then moved by means of the screw until it appears to lie in contact with the other edge of the object. The number of notches on the scale

shows how many complete turns of the screw have been made in separating the filaments, while the number to which the index points on the graduated head of the screw shows what fraction of a revolution has been made in addition. Besides determining, by means of the stage micrometer, the value of the divisions of the scale, it is necessary, for very exact measurements, to make an accurate estimate of the thickness of the filaments themselves, since, if this is not allowed for, a serious error may be introduced, especially when the spaces measured are extremely minute. Queckett, in his *Practical Treatise on the Use of the Microscope*, has shown the theoretical possibility of measuring spaces as small as the 1-800,000" with an $\frac{1}{8}$ " objective and this micrometer, but there are practical difficulties in the way of attaining this.

The eye-piece micrometer can be introduced into the eye-piece when making drawings by means of the camera lucida or any other of the apparatuses used for drawing with the microscope, and the divisions of the micrometer sketched at the side of the drawing, as in working with the stage micrometer.

Abbé's form of apparatus, used for drawing, though more expensive and complicated than the Wollaston or Beale, is a very convenient form to work with. It consists of a cube of glass cut across diagonally. The cut surface is silvered, all but a small patch in the middle, and the two pieces are cemented together again. This is then fixed over the eye-piece, in a suitable frame, so that the sheet of silvering inclines downwards from left to right, with the unsilvered patch immediately over the centre of the eye-piece. Attached to an arm extending out towards the right is an ordinary silvered glass mirror, the plane of which can be adjusted around a horizontal axis, parallel to the silvered surface in the cube, and at the same vertical height as the centre of the unsilvered patch. The drawing paper is placed under this mirror, touching the foot of the microscope, and the mirror revolved, till, on looking perpendicularly down the microscope at the object to be drawn, through the unsilvered patch, the object and the reflection of that portion of the paper next the microscope are seen together. The drawing surface is reflected, first, from the mirror at the end of the arm on to the cemented surface in the cube, the angle of which is so adjusted as to throw the image vertically up into the eye. The point of the pencil is very easy to see in this form of apparatus. With low objectives and a good light, the field is lighter than the reflection of the drawing surface. With stronger objectives it is necessary to reduce the brilliancy of the reflection of the drawing surface. This is done by the insertion of one or two neutral-tinted glasses between the two mirrors, in frames prepared for them. There is a third frame to hold a lens suited to the eyes of any one with abnormal sight who uses the instrument, the centre of the lens being opposite the unsilvered patch. This, of course, has to be made to order. When the drawing surface is horizontal the enlargement of the drawing is somewhat distorted, unless the centre of the drawing is perpendicularly below the centre of the mirror.

If this cannot be arrived at by rotating the mirror on its axis, a longer arm can be used to support the mirror, or, since the error is very slight, the drawing surface can be inclined about 10° so as to bring it at right angles to a line joining these two points.

Prizes for Microscopical Work.

By C. A. STEPHENS,

NORWAY LAKE, ME.

From a desire to verify my own researches as to the causes of failing nutrition in aging organisms, I offer three cash prizes of \$175, \$125, and \$100 for the best three comparative demonstrations, by means of microscopical slides, of the blood capillaries in young and in aged tissues, canine or human.

By young tissues (canine) are meant tissues from animals between the ages of one and three years. By aged tissues (canine) are meant tissues from animals not less than twelve years of age. By young tissues (human) are meant tissues from subjects between the ages of ten and twenty years. By aged tissues (human) are meant tissues from subjects not less than sixty-five years of age.

While a preference will be given to demonstrations from human tissues, it will be possible for work in canine tissues to take the first and, indeed, all of the prizes. But of two slides equally well done in all respects, one canine, the other human, the latter will be given the preference. Canine tissues should be from large animals.

Twelve slides from young and twelve from aged tissues must be submitted by each competitor, together with a full description of the subjects, methods pursued, and every detail and circumstance which is likely to throw light upon or account for any peculiarity. The slides are for comparison as to the condition of capillary circulation, the young with the old, and should be in numbered pairs or groups from the same kind of tissue. The term tissue is used in a general sense, *e. g.*, pulmonary tissue, hepatic tissue, renal tissue, osseous tissue, muscular tissue, nerve tissue, alimentary tissue, etc.

No particular schedule of methods for injection or staining will be insisted upon, and no more definite directions or explanations will be given. The slides, carefully packed and boxed, together with descriptive manuscript, can be sent by mail. It is stipulated that the demonstrations which receive the prizes shall become the property of the subscriber, for publication. All others will be returned, if desired.

No pseudonyms required. Accompany slides in every case with (real) name and address. Unless of known reputation as a biologist, a reference is respectfully solicited. Reservation: No award will be made unless work of at least ordinary merit is submitted. This offer is made on the first day of January, 1890, and will remain open until the twentieth day of August, 1890. The prizes will be adjudged on the first day of October, 1890.

These nominal prizes are offered less in expectation of results from the money as an agent than in the hope that the offer may furnish a *point d'appui* for really needed work. Besides professional observers and students, there are in the United States a large number of amateur microscopists of acute vision and undoubted talent who are at present playing with microscopes, as with toys, merely to see curious or pretty things. The time has come to concentrate observation upon the one proper object of biology, viz., the renovation and prolongation of human life.

The Colored Screen in Photo-Micrography.

[ABSTRACT.]

BY PROF. ROMYN HITCHCOCK.

An ordinary gelatino-bromide plate is sensitive to the spectrum of sunlight from a point between the Fraunhofer lines E and F to about K. The maximum photographic action is about G. By considerably prolonging the time of exposure the limit of photographic action at the red end of the spectrum is greatly extended. In practice the light below the green of the spectrum may be regarded as quite inactive when we take photographs with ordinary plates.

By introducing a colored screen, a plate of yellow glass for example, in the path of the light, we may absorb the more active rays, and prolong the time of exposure until the yellow rays have time to act upon the sensitive plate. In practice, however, it is found that there are two difficulties about this method of procedure; first, in obtaining a satisfactory screen, and second, in the long exposure necessary when working with the comparatively inactive rays.

With color-sensitive plates, such as are now in general use abroad and gradually being introduced in this country, the range of photographic action towards the red is greatly extended. With such plates the yellow screen can be used with great advantage.

A few years since it was customary to work with monochromatic blue light in photo-micrography, and the ammonio-sulphate of copper blue cell was much in use. When color-sensitive plates were introduced yellow screens took the place of blue, because it was found that many specimens had yellow and red and brown parts which were not well photographed with blue light.

The color and thickness of the screen both require attention. If it be too thin the blue light is not sufficiently cut off. In particular cases an almost monochromatic yellow light is desirable, as when it is desired to obtain sharp outlines of deeply stained objects regardless of structural details. But generally a rather broader spectrum range is desirable, for the light employed should correspond to the different colors or shades of color of the object. It is owing to neglect of this consideration that we often see photo-micrographs which are mere silhouettes, while the objects show much more structure to the eye. This is frequently observed in photographs of such structures as the tongue and sting of a bee and legs of insects. In other preparations in which the color is a stain—brown or red for example—the fault lies partly in the exposure, which, in many cases, is insufficient to give more than outlines and blank interiors. This is frequently noticeable in photographs of bacteria.

By a proper choice of a screen, if a screen is required, a photograph should show any object as clearly as we can see it in the microscope.

Color-sensitive plates may be said to be indispensable in the photography of rock sections with polarized light.

The yellow solution devised by Prof. Zettnow, of Berlin, is used with much favor by many workers. It is composed as follows: Copper sulphate, 175 grammes; potassic bichromate, 17 grammes; water, 1,000 c.c.

The true function of the color screen should be to give definition and detail, not to increase contrast between the object and the field, as many observers seem to believe.

A Point in the Use of Oil of Cloves.

By W. HATCHET JACKSON,

DEPUTY LINACRE PROFESSOR OF ANATOMY, OXFORD, ENG.

Oil of cloves is very generally employed to clear up sections that have been dehydrated previously to mounting in Canada balsam or Dammar varnish. It sometimes happens that the sections turn milky on the addition of the oil. I found that the students in the morphological laboratory here regarded such sections as useless and spoilt, a belief, as I have reason to suppose, not confined to them.

The remedy is a simple one. If a small quantity of oil is poured on the sections whether already fixed to the slide or not, and then the whole is gently warmed for a short time, an operation readily performed on the water-bath used to melt the paraffin for imbedding purposes, the milkiness disappears. If it does not disappear at once, the oil on the slide should be poured off, fresh oil added, and the heating repeated.

The rationale of the process depends upon the fact that the milkiness is due to a combination between the essential oil and a small residual quantity of water. I have seen this compound termed a camphor in a chemical text-book; but whatever its nature may be, it is readily soluble by the aid of warmth in an excess of the essential oil.

If heating the slide is objectionable, repeated soaking in absolute alcohol will effect the same end. But it is much more troublesome and takes a longer time.—*Zoologischer Anzeiger*, Dec. 2, 1889, p. 630.

Report upon the Postal Club Boxes.—IX.

By QUEEN MAB.

The first box of the season arrived December 4, after a five-months' intermission. The delay is explained by the fact that there has been negligence in a few localities about properly forwarding the boxes. It is of greatest importance that each member adhere strictly to the rules of the Club, and thus make possible the circulation of a large number of slides. From thirteen to eighteen boxes of six slides each were sent out last year. It is hoped to circulate as many within the next seven months.

Box B.—This is of interest, both for what it is and for what it suggests. The German laboratories have helped to give an impetus to American microscopy within the last few years, and the preparation of certain classes of objects has reached a degree of perfection little short of marvellous. But the permanent preparation of objects, which is of comparatively recent origin, has made no such advances. Indeed, one often sees an incongruity between skilful preparation and unskilful preservation. Labor is almost wasted which might easily be made effective. There is, however, a diversity of opinion, even among our most noted preparers, as to the best methods of permanent preparation. Some insist that balsam is the best medium for certain classes of ob-

jects, while others affirm as strenuously that the refractive index of balsam is such as to obliterate features that would be brought out by other media, and not only so, but that it produces an inadmissible degree of shrinkage which results in distortion. As to glycerine, everybody knows its liability to exceed prescribed bounds, and the readiness with which it clouds objects containing lime. In the matter of cement there is ample room for improvement. Two of the most valuable preparations in Box B are doomed because of the fallibility of the cements used. One of these cements is white zinc which has chipped off the outside of the mount, threatening at the same time the inundation of the object. The other is ringed with asphalt, or Brunswick black. Its use in this instance was a misuse. The two slides which have withstood the perils of mail transit since they started out eighteen months ago are ringed with King's cement, one of them being a dry mount (the class most short-lived among the Club slides).

No. 1 is a "vertical section through the apothecium of the lichen *Physcia stellaris*, prepared and contributed by Rev. A. B. Hervey, Taunton, Mass. Objective to be used, $\frac{1}{8}$. This is a widely-distributed genus of lichens, and in its spore formation represents a large group of genera. The spores are quite similar in their form and development to those of the Discomycetous fungi. They arise from the transformation of the protoplasm in the fertile filaments (asci) of the apothecium. They are bilocular and occur in groups of four double spores in each ascus. By a careful examination of the specimen the various stages of the development of the spores may be made out."

No. 2, by F. A. Hubbard, Taunton. *Bacillus tuberculosis* in sputum, from 3d stage. Prepared on cover-glass with Gibbs' Double Stain, according to Reeves. Objectives, $\frac{1}{8}$ to $\frac{1}{16}$ (600 to 3,000 dia.) "The tubercle bacilli are stained dark and stand out prominently, while the epithelial scales, pus cells, and other microbes, such as bacilli and micrococci have taken the violet stain." The tubercle bacillus is from $\frac{1}{4}$ to $\frac{1}{2}$ the diameter of the red blood corpuscle.

No. 3, prepared by W. H. Pratt, Taunton (Diatoms from Buzzard's Bay), is characterized as a very fine mount.

No. 4, prepared by Dr. Leslie, of Canton, is a section of Epithelioma, stained with carmine, and the amplification advised is from 50 to 600. Pearl nests very nicely shown.

No. 5 is the work of Dr. Peet. The subject is *Deutzia gracilis*, nine sections of which, including stem, leaf, petal, anther, stigma, and receptacle, are double stained.

No. 6 is prepared by Miss Drury, of Natick, the well-known instructor in microscopy at the Martha's Vineyard Summer Institute, and consists of sections of *Larix americana*. Dark-ground illumination is suggested to bring out the beauties of the preparation. The stain used is hæmatoxylin.

Miss V. A. Latham (F. R. M. S.)—This lady has recently been elected to the chair of Demonstrator in Pathology in the University of Michigan. Prof. Latham is the first lady who has held any office in the Medical Department of the University, and has our congratulation and best wishes for her success.

BIOLOGICAL NOTES.

BY PROF. J. H. PILLSBURY,

NORTHAMPTON, MASS.

Vegetable Preparations.—Plant tissues which usually turn dark in alcohol may be prevented from doing so, according to the *Botanical Gazette*, by adding to the alcohol two per cent. of hydrochloric acid, without interfering at all with the quality of the tissues for microscopic study.

Vaccinium vitis-idaea.—This interesting little plant, called the “low bush cranberry” in its abundant and native habitat in northern Canada, is reported by J. M. Macoun, in *Forest and Stream*, as producing fruit of a flavor much more agreeable than when growing farther south. “Throughout the whole of northern Canada, hunters and trappers, as well as the native Indians, have frequently to depend upon it for food when game and fish are scarce.” Many migratory birds subsist largely upon it at certain seasons of the year, while the black bear finds its flavor agreeable to his semi-fruit-loving taste and scratches up large areas of the vines in search for the fruit.

Inoculation for Rabies.—No fewer than 1,810 patients bitten by dogs were treated at the Pasteur Institute during the year ending Oct. 31. There were thirteen deaths.—*Nature*.

Has any one ascertained the number of deaths occurring from the bites of dogs when no treatment save such as would be given to ordinary wounds has been used?

Dwarf Trees.—At the Royal Botanical Society of London a dwarf Japanese *Thuja obtusa* said to be 130 years old and only about two feet high was exhibited. The society's garden is said to contain several specimens of the common oak between forty and fifty years old, yet only ten or twelve inches in height. These are interesting illustrations of the possible modifications of plants under peculiar environments or subjected to unusual artificial conditions.

Staining Paraffin Sections.—Those who have used the paraffin imbedding method for serial sections have doubtless wished for some simplification of the process of staining. This may be done, according to Dr. Küenthal, by dissolving the coloring matter in absolute alcohol and dropping the solution into turpentine until the desired depth of color is secured. Sections fixed to the slide with the collodion are kept in the oven until the clove oil has completely evaporated, the paraffin dissolved in turpentine as usual and the slide brought into the dye. The staining is quickly effected. Over-staining may be corrected by placing the slide for a short time in a mixture of acid-free absolute alcohol and turpentine (equal parts). Turbidity of the coloring fluid may be corrected by adding a drop or two of alcohol. Meyer's carmine, methyl green, methyl blue, gentian violet, safranin, Bismarck brown, eosin, fuchsin, tropeolin, and malachite green may be used in the above ways.—*Botanical Gazette*.

Circulation of Fluids in Plants.—By the use of sulphate of iron solution ($\frac{1}{5}$ to $\frac{1}{10}$ per cent. solution), and subsequent treatment of the tissues of the plant with a solution of pure cyanide of potassium, Bokorny (see *Biologischer Centralblatt*, ix, 289) has determined the course of the circulation of the fluids of plants. The fibro-vascular

bundles of both woody plants and herbs afford the chief channel for the flow of water through the plant and principally in the xylene of the bundles.

Teeth of Ornithorhynchus.—*Nature* for Nov. 7, p. 11, contains a note upon the teeth of this curious mammal and the early discovery of them by Sir Edward Horne, to which, in the same magazine for Nov. 14, p. 31, Prof. Flower replies, showing that the teeth referred to by Mr. Horne are the adult plates or scales, and not the teeth of the young Ornithorhynchus discovered by Mr. E. B. Poulton, and communicated to the Royal Society, Feb. 9, 1888, and described in vol. xlvi, 1889, pp. 126–128 of the Proceedings of the Society.

Zoology of the Bermudas.—A very valuable contribution to biological literature is Angelo Heilprin's "Bermuda Islands." While seeking to be a popular treatment of the physical and zoological features of this very interesting group of islands, it is, at the same time, both interesting and valuable as a contribution to the scientific knowledge of the fauna of the islands. The number of species of animals known to naturalists is largely increased by Mr. Heilprin and his able collaborators in the publication of this volume.

BACTERIOLOGY.

By V. A. MOORE,

WASHINGTON, D. C.

A New Method of Staining Flagella and Cilia of Micro-Organisms.*—A method of staining bacteria has been devised by Professor Loeffler, which is especially intended to demonstrate their flagella. The cilia of infusoria and monads are also brought out very distinctly by the use of the same method. The principle involved in staining these minute structures is, according to Professor Loeffler, the subjection of the preparations to the action of the mordant before they are placed in the staining fluid. After many trials the author hit upon the following procedure, which he pronounces to be satisfactory.

The Mordant.—To 10 c.c. of a 20 per cent. solution of tannin a sufficient quantity of an aqueous solution of the sulphate of iron is added to give the fluid a dark violet color. To this is added 3 to 4 c.c. of a logwood decoction (1 part wood, 8 parts water). The liquid will now have a blackish violet color. Care must be taken not to add an excess of the logwood as it would interfere with the staining process. When prepared the mordant should be kept in a well-stoppered bottle, and in order to preserve it, 4 to 5 c.c. of a 5 per cent. solution of carbolic acid may be added.

The Staining Fluid.—To 100 c.c. of a saturated watery solution of aniline oil is added 1 c.c. of a 1 per cent. solution of sodium hydrate to give to it a slightly alkaline reaction. This alkaline aniline water is poured into a flask in which has been placed 4 to 5 grams of powdered methylene blue, methyl violet, or fuchsin. The flask is vigorously shaken and closed with a tightly-fitting rubber cork. This solution can be kept for a considerable length of time. It must always be filtered before using.

* Centralblatt f. Bakteriologie u. Parasitenkunde, vi (1889), p. 209.

The material to be examined must form a very thin layer upon the cover-glass. If the germ-containing substance is albuminous a very small quantity of it is added to a drop of sterile distilled water on a cover-glass and thoroughly mixed with it; a small quantity of this is conveyed to a second cover-glass and treated in a like manner; and again from the second a third preparation is made. By this treatment the albuminous substance is sufficiently diluted, and the microbes are isolated in a watery medium. The preparations are allowed to dry in the air, after which the films are fixed by passing the cover-glass film upward through a flame in the usual manner.

A few drops of the mordant are poured over the film, and the cover-glass held over a flame until the fluid begins to evaporate. It is then removed from the action of the flame, and after a very short time the mordant is washed off in a stream of distilled water. Care should be taken to remove all traces of the mordant from the edge of the cover-glass, as it would form, if present, a very troublesome precipitate with the staining fluid.

The next step is to filter a few drops of the staining fluid upon the film. This is allowed to act for a brief time, when the cover-glass is held over a flame and gently heated. Better results are obtained if the staining fluid is only slightly warmed and allowed to act for a longer period.

As soon as the film becomes darkened (a blackish red if fuchsin is used) the stain is washed off in distilled water. The preparation is now ready for microscopical examination. This can be made at once in a drop of distilled water, or the preparation allowed to dry and mounted in balsam.

The microbes with their flagella should be deeply stained, resting upon a colorless background if the germs are in a purely watery medium, but if albumen is present they are surrounded by a uniformly feebly stained medium, the intensity of which depends upon the quantity of albumen in the film.

With this method Professor Loeffler has succeeded in demonstrating the flagella on a large number of motile bacilli, spirilla, and also upon the motile micrococcus recently described by Ali. Cohen.

EDITORIAL.

Our First Decade.—This journal was founded in January, 1880, and has therefore completed its first decade. It is the oldest microscopical journal now published in the United States. Its founder and well-wisher, Prof. Romyn Hitchcock, still lives in Washington, and although devoting his time largely to chemistry and photography, contributes an article to the present number. During the past two years a constant increase in the subscription list has enabled us to furnish many fine illustrations and to increase the size of the journal.

Each volume has had its index, but a combined index for 10 years would be valuable to those who have the complete series. Owing to the absence of the earlier subscription lists and to the fact that many do not preserve their numbers, it is impossible now to say how many sets are in existence. As a matter of statistics and to enable us to decide

whether or not to prepare a ten-year index, we request every subscriber to send us a postal card on which is stated the number of volumes (and their years) which he has preserved.

The early volumes have become so scarce as to command a good price, thus showing the wisdom of the investment made by those who have preserved them. Several of our later subscribers, appreciating their value, have given us standing orders to procure certain early volumes for them at the earliest opportunity.

By a curious turn of events the only man who has ever established a rival microscopical publication, Dr. C. H. Stowell, is also a fellow-resident of Washington, he having recently removed from Ann Arbor, Mich., to practice medicine in this city. American microscopy owes a debt of gratitude to Professor Hitchcock and to Doctor Stowell, not soon to be cancelled, and we hope never to be forgotten. We shall prize their friendship, however preoccupied they may become in other subjects, during the coming years.

That microscopical periodicals are wanted and appreciated is becoming more and more apparent. We shall try while engaged in the work to always meet the demands and thus hope to secure the commendation of the votaries of this science, both amateur and professional. To all we wish a Happy New Year.

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Subscription Agencies.—Our contemporary, the *Botanical Gazette*, announces that it has severed all connection with subscription agencies. We are tempted to do the same on account of the many tricks that disreputable agencies resort to. There is one in New York City which took the money of a subscriber last July, and not only failed to turn over the money to us, but absolutely neglects to answer all letters of inquiry about it.

From this time onward we will not consider subscriptions paid until the money is in our own hands. If patrons order through agencies they must assume all responsibility, and not regard the agents as *our* agents in any sense.

But in order that all may get their periodicals at the lowest rates, we will club the JOURNAL to any extent desired, and at the lowest rates that any one who does honest business can afford to offer.

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Payments.—We are already in receipt of a large number of payments for 1890, for which many thanks. Please notice the date on your wrapper, and if it does not correctly indicate the date to which you have paid, inform us at once.

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Binding.—We will as heretofore bind your copies of the JOURNAL for 35 cents (postage 10 cents), provided you send the numbers by Feb. 5, at which time the entire collection will be handed to the binder. The bound volumes will be sent to you as early in February as possible. The binding is a neat one, in black cloth, with the usual lettering on the back. If you prefer you can buy the "case" from us for 28 cents, postpaid, and get a local binder to insert your numbers in it. Remittances for these small amounts must not be in 2-cent stamps, for we have a year's stock now. You can send 1-cent stamps, or better, a postal note.

Slides Received.—We return thanks to the donor for the following interesting slide: Silicified wood from Colorado, evidently one of the Coniferæ, as is seen from the cell-wall markings. Prepared by Prof. J. Brownell Rogers, Montpelier, Vt.

BOYS' DEPARTMENT.

A Popular Error About Water.

By E. C. HOYT,

DETROIT, MICH.

If the average clergyman could be induced to spend a week over a good microscopical collection, in the company of an enthusiastic microscopist, he might save himself and his boy hearers from a common error often incorporated into sermons. In a late sermon, by a Brooklyn divine, upon the wine of Cana, he said: "Beautiful miracle! A prize was offered to the one who should write the best essay about the miracle in Cana. Long manuscripts were presented in the competition, but a poet won the prize by one line descriptive of the miracle, 'The Conscious Water saw its God and Blushed.' If you have a microscope, put under it one drop of water, and see the insects floating about; and when you see that God makes them and cares for them and feeds them, come to the conclusion that he will take care of you and feed you."

How many boys, and others, who are beginners with the microscope, have been at some period in their incipency just as much at sea about a drop of water as was this clergyman.

"Insects floating about" in a drop of water is good.

A few years ago a young man came to the town in which I lived, and gave exhibitions with three or four microscopes, under one of which he showed what he called "A drop of water taken from the Detroit River." I had, at that time, over a thousand dollars' worth of microscopical goods; I had learned that there was water in which animal life exists, and water in which there was none. I had myself vainly searched for hours in canal water for a single sign of animal life.

It so happened that this man remained in town for several days, and, stopping at the same hotel, I formed his acquaintance. I found him to be one of the best posted men on the microscope I had ever met. He asked me to take a walk with him. Provided with fruit jars, dippers, and cloths, we found, by the river, half a mile below the town, a stagnant pool. We dipped up pail after pail of water, strained it, and saved the animalculæ, until we had collected the life from a barrelful or more of this stagnant water. We took our fruit jars home. We then strained the contents of one jar into a few drops and had an elegant supply of "insects" for the evening's entertainment. I saved my jar and had an aquarium for many months. After this I knew more about "a drop of water."

In order for the water that was converted into wine to have been "conscious," *i. e.*, to have contained life, it must have been grossly stagnant. The poet's metaphor had no foundation in fact.

MICROSCOPICAL SOCIETIES.

WASHINGTON, D. C.—L. M. MOOERS, *Secy.*

December 10, 1889.—97th meeting. A letter was received from Mr. H. Doubleday, presenting to the Society ten boxes of slides prepared by Arthur J. Doherty, of Manchester, England. A paper was read by Mr. V. A. Moore on "The media employed in the cultivation of Bacteria, with the method of preparing some of the more important varieties." It is difficult to differentiate germs by microscopic examination alone, but they are now diagnosed by their behavior on culture media. Every germ shows on a proper medium a characteristic and constant form. A most important consideration in culture studies is the thorough sterilization of the medium, without which satisfactory results cannot be obtained. To beef infusion, 1 per cent. of peptone, $\frac{1}{2}$ of sodium chloride, and 2 c.c. sod.-carb. are added, filtered cold and sterilized by boiling at intervals. Short boiling at intervals makes sterilization more certain, and gives a better culture medium than prolonged boiling at one time. The preparation of the various other liquid media was described, and also the behavior of different germs on them. The principal solid media are agar, serum, gelatin, and potato. Gelatin is sterilized by boiling three minutes for five successive days. One difficulty in the preparation of agar is the formation of precipitates. This can hardly be avoided even with the greatest care. Potato is easily prepared, and is one of the best of media for many varieties of germ.

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THE ST. LOUIS CLUB OF MICROSCOPISTS.

October 1, 1889.—C. M. Nicholson read a paper on the microscopy of the mountain sage. It was accompanied by specimens from the drug. C. C. Ferris continued the subject of mounting mediums for starches. A. C. Speth announced that he had found a substance in caramel similar to glycyrrhizin. E. J. Nitzschmann presented specimens of the different kinds of lice found on the human body, and explained how they were mounted.

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BROOKLYN MEDICAL MICROSCOPICAL SOCIETY.

27th Meeting, Nov. 6, 1889.—Dr. Heitzmann presided at the Hoagland Laboratory. Dr. L. E. Tieste, of Brooklyn, was elected to membership. A demonstration of prorsperm, the anthrax bacillus, and the micrococcus tetragonus was made by Dr. Van Cott. This called forth discussion by Drs. Wilson, Weeks, Heitzmann, and Van Cott, in which the value of tetragonus as a factor in the diagnosis of developing lung cavities was maintained.

28th Meeting, Dec. 4, 1889.—The Society met at the Hoagland Laboratory, the President, Dr. C. Heitzmann, occupying the chair. The names of Drs. Eugene Hodenpyl and Ira T. Van Giesen were proposed for membership. The paper was by Dr. E. H. Wilson, on the "Technical Methods for the Central Nervous System."

The paper was warmly discussed by Drs. Shaw, C. Heitzmann, L. Heitzmann, Eccles, Bates, and Lennox, the consensus of opinion being in favor of the hæmatoxylin method of Weigert.

ESSEX CO., N. J.—F. VANDERPOEL, *Secy.*

September 26, 1889.—The annual meeting was held at the residence of the secretary. In the absence of the president the chair was occupied by Mr. Jay L. Smith, of South Orange. The Society elected officers for the ensuing year as follows: President, Jay L. Smith; secretary, Frank Vanderpoel; treasurer, Geo. S. Woolman; executive committee, Dr. G. S. Allan, Rev. Albert Mann, Jr., Mr. C. H. Loomis.

The members were instructed in the art of photo-micrography by the newly-elected president, who, with his P. and L. stand and a very compact camera of his own design, photographed an embryo chick of thirty-six hours incubation. The whole operation of exposing and developing the plate was performed in the presence of the Society. The process was clean and neat enough to be performed in one's parlor.

Thursday, October 10, 1889.—Met at the residence of Mr. J. L. Smith, in South Orange. A paper on the subject of tumors was read by Mr. W. C. Gardner. It included a general classification, with description of the growth and development, and opinions of various authorities upon their causes and cure, and was illustrated by charts and slides. In the discussion which followed the question as to the cure of certain kinds of cancers was debated by the medical men present. The very diagnosis of a cancerous growth seemed to be a matter of considerable doubt. Some authorities were quoted as favoring the test afforded by the insertion of a hypodermic needle into the suspected growth and the microscopic examination of the fluid extracted. By others this test was not considered infallible, and, in the end, the question still remained an open one. All were agreed, however, as to the great importance which the microscope assumed in the diagnosis of a case of real or supposed cancer. A few slides were shown through the tube, among them a section of small-celled sarcoma and a carcinoma.

October 24, 1889.—At the residence of Dr. J. B. Hawes, Montclair. The president, Mr. J. L. Smith, read a paper on the subject of cancers, a sort of sequel to or continuation of the paper of Mr. Gardner's read at the previous meeting. The three varieties of cancer—sarcoma, carcinoma, and epithelioma, were fully described and the paper was followed by an exhibition of slides on the screen and under the microscope. The slides which were shown by means of the lantern were: 1. Small round-celled sarcoma of liver. 2. Large round sarcoma of leg. 3. Alveolar sarcoma from tibia; and two or three others of a similar nature.

With the microscope there were shown a tubulated epithelioma from the tongue, epithelioma of the nose, myxo-sarcoma of the supra-orbital ridge. A cell nest in epithelioma from the nose was shown in a very beautiful manner; it looked almost diagrammatic, from being so well defined. Then there were exhibited a spindle-celled chondro-sarcoma and a giant-celled sarcoma.

After the reading of the paper, Dr. Allan said that he wished to make a statement with reference to a certain article upon the subject of dental caries, which appeared in the June number of *The Microscope*, in which the author of the article combatted and ridiculed the theories of Dr. Miller, of Berlin.

This article Dr. Allan considered to be full of misstatements, and it would be reviewed by him at an early date in a paper which he would read before the Society, and would wish to have published in as prominent a manner as the paper referred to.

November 7, 1889.—At the residence of Mr. W. W. Underhill, Montclair. The paper for the evening was by Professor Julien, who instructed the members in the art of making rock sections. The preparation of these sections by grinding was very fully explained, and a large number of slides exhibited on the screen. Their internal structure was very beautifully exhibited by means of the polariscope, and the component minerals disclosed.

The list included granite, pyroxene, agate, tourmaline, gneiss, micaschist, demyte, olivene serpentine, diorite, norite (from the Adirondacks), pudding stone from England, sandstone from Dorchester, and many building stones.

The value of the microscope and polariscope in determining the qualities of a building stone were made very evident, as the internal structure of the rocks could be so easily observed, and also the cementing material which united the different minerals. Altogether the lecture was very enjoyable and instructive.

IRON CITY MICROSCOPICAL SOCIETY.

Tuesday evening, Dec. 10, 1889.—The exercises were opened with a talk by Rev. W. J. Holland, on the "Best Methods of Mounting Insects." The modes of collecting, preparing, and stretching were fully discussed and explained, the more intricate points being illustrated by drawings. Regarding the best method of collecting moths, the lecturer described the mode used by himself. He made a mixture of common brown sugar and stale beer, applying it to the forest trees on the side towards the moon, with a common whitewash brush. Then approaching the tree cautiously, using a dark lantern, he was enabled to pick off the moth wanted. In this way he collected over 600 specimens in one night in Southern Indiana. The best mode of killing the Lepidoptera is with potassium cyanide. To prepare this important part of a collector's outfit, procure a wide-mouthed bottle (Scherin's chloral hydrate bottles are best), drop in two or three pieces of potassium cyanide about the size of hickory nuts. Then cover the cyanide loosely with a few layers of paper. The common method is to imbed the cyanide in plaster of paris, but in Mr. Holland's experience the method used is superior to the other.

Mr. C. C. Mellor then entertained the large audience present with a lantern exhibition, using a McIntosh lantern with a 2" objective. The objects thrown on the screen were clearly and sharply defined. The usual exhibition of slides followed: W. J. Prentice, exhibiting section of Canada pine; J. H. McRoberts, a section of red oak; J. G. Ogden, section of lung of kitten, injected; J. A. Moore, pollen of corn. [Reported by Gordon Ogden.]

NOTICES OF BOOKS.

Elementary Mathematical Tables. By A. Macfarlane, LL. D. 8°, cloth, 112 pp. Ginn & Co., Boston. Price 85 cents.

This collection of tables contains logarithms, antilogarithms, addition and subtraction logarithms, logarithmic sines and cosines, logarithmic tangents and cotangents, natural sines and cosines, natural tangents and

cotangents, natural secants and cosecants, arcs, reciprocals, squares, cubes, square roots, cube roots, circumferences, circular areas, spherical contents, powers, constants, hyperbolic logarithms, exponentials, divisors, least divisors, interest tables, first nine multiples of numbers up to 1,000, with many auxiliary tables. The tables are designed to be useful in computing, in the graphic method, in teaching arithmetic, and also in the illustration of the theorems of algebra. The tables are mostly four-place; they have a uniform decimal arrangement similar to that of seven-place logarithmic tables. They are mostly synoptic, and are arranged so that the function may be read off for any position of the decimal point in the argument.

Catalogue of Microscopes and Accessories. By W. H. Bulloch, Chicago. 8°, pp. 40.

This catalogue is presented to the public for the purpose of introducing some recent and very useful microscopic improvements. Among the features which deserve especial mention are the full descriptions of the several microscopes, the mechanical stage, the Congress microtome, and the large assortment of objectives. Those interested in the very latest improvements in microscopic apparatus would do well to obtain a copy.

Cynewulf's Elene. Edited by Charles W. Kent. 12°, 149 pp. Ginn & Co., Boston. (Price, 65 cents.)

In the introduction to this work the editor gives an account of the manuscript, author, theme, plan, and literary merit of the poem. A metrical introduction is also included, giving the marked characteristics of Old English verse. The Bibliography, which occupies four pages, is of especial interest.

The text is accompanied by the Latin original at the foot of each page. The 1321 lines of the poem are numbered for easy reference. The notes are full, and frequent reference is made to Cook's Sievers' Grammar, and many of them are transcriptions from the author's *Teutonic Antiquities in Andreas and Elene*. A complete glossary closes the volume.

Animal Physiology. By Wesley Mills, M.D. 8°, 700 pp. 505 figures. D. Appleton & Co., New York.

This text-book of Physiology by Prof. Mills, of McGill University, is a very different book from those which we have been accustomed to. The same advance which we have noticed in other branches of science is evident here. As a basis for the study of medicine or of the outlines of biological science, no better book can be found at the present time. The first hundred pages relate more especially to biology. The whole subject is presented in concise, but very intelligible language, which with the abundant illustrations admirably adapts the book for college instruction. Each chapter is closed with a summary of its contents.

Embryology has been marshalled to illustrate physiology in a skilful manner. While comparisons are frequently made between the organs of man and other animals, the author especially guards against the gratuitous assumption that the action of similar organs is the same in man and the lower animals. The demonstration of a function in a quadruped is only to be used presumptively in reasoning on similar functions in man.

The author does not attempt instruction in microscopic anatomy, but his book is nevertheless a remarkable demonstration, the work now being done with the microscope. A great number of the figures are of microscopic objects, and a large part of the information given has been derived by the use of the microscope. Among the topics illustrative of this fact are the cell, yeast, protococcus, proteus, mold, bacteria, vorticella, polyps, etc., in the chapters on general biology; the character and composition of the spinal cord as shown in sections; the papillæ of the skin and tongue; the circulation of the blood in the web of a frog's foot, etc. In the chapter on blood are given good illustrations of the leucocytes, the corpuscles, and the blood plaques. The blood is discussed not only microscopically, but chemically. There is a folded plate representing gastrulation which is deserving of especial mention. Therein are figured eggs of amphioxus, frog, man, fish, and crab, credit being given to Haeckel therefor. The whole subject of reproduction is fully and clearly set forth. Under this chapter are shown the microscopic structure of the placenta. Many other subjects would be worthy of special mention did our space permit. Those of our readers who are teachers of physiology would do well to have the book in their libraries, as it would enable them to supplement smaller and older treatises in a highly satisfactory manner.

SUBSCRIBERS' NOTICES.

[These notices will be given six insertions in this column at 25 cents per line or fraction thereof.
 FOR EXCHANGE.—Slides of selected diatoms. D. B. WARD, Poughkeepsie, N. Y.

WANTED.—Unmounted microscopical material, also micrographic dictionary. Will exchange or buy. CHARLES VON EIFF, 124 Clinton Place, New York City.

WANTED.—A clean copy of Rev. William Smith's British Diatoms, and Schmidt's Atlas of the Diatomaceæ. JAMES B. SHEARER, Bay City, Mich.

OFFERED.—Diatomaceous Earth from Utah (Desert) for Histological Mounts. PROF. ORSON HOWARD, Salt Lake City, Utah.

CORRESPONDENCE invited with a view to the exchange of either mounted or unmounted Oribatida (British) for American species. E. BOSTOCK, Stone, Staffordshire.

WANTED.—Any works on Microscopy not already in my Library. H. M. WHELPLEY, F. R. M. S., St. Louis, Mo.

WANTED.—(In exchange for slides.) "Microscopical Bulletin," Vol. I. No. 5, August, 1884. M. S. WIARD, New Britain, Conn.

Labels in exchange for slides. EUGENE PINCKNEY, Dixon, Ill.

First-class Histological Slides for other good mounts; Histological and Pathological material cut on shares. S. G. SHANKS, M. D., 547 Clinton Ave., Albany, N. Y.

OFFERED.—Griffith & Henfry Micrographic Dictionary to be sold; also Hoggs Microscope. J. P. WINTINGHAM, 36 Pine St., N. Y.

WANTED.—A clean copy of Wolle's Fresh-Water Algae of the United States (2 vols.); also good second-hand Grunow Camera-Lucida, and a self-centering Turn-table. JOS. P. THOMPSON, P. O. Box 1383, Portland, Me.

FOR SALE CHEAP.—New Gundlach $\frac{1}{16}$ homogeneous-immersion objective, for $\frac{1}{20}$ glycerine or water objective.

FOR SALE.—A Bausch & Lomb Stand, A. & C. eyepieces, 1 in. and $\frac{1}{2}$ in. objectives. BOX 1, Evanston, Ill.

FOR EXCHANGE.—Cabinets of lower silurian fossils for microscopical apparatus. Correspondence invited. E. L. SHERWOOD, Houston, Miss.

OFFERED.—\$400 in prizes. For details see article in January number of this journal for 1890. C. A. STEPHENS, Norway Lake, Me.

List of Walter White's Botanical Sections and Other Objects Ready for Mounting or for Examination.

By CHAS. W. SMILEY,

WASHINGTON, D. C.

	No.		No.
Yeast. Simple globular vegetable cells, showing nucleus	1	Brake fern, oblique sect. Scalariform vessels, sieve tubes, &c. . .	30
Crown Imperial. Root L.S. Protoplasts in cells	2	Maize. Annular vessels in fibrovascular bundle	31
Orchid (<i>Oncidium</i>) Leaf. Fibro spiral cells, isolated	3	Pumpkin L.S. Sieve tubes	32
Elder pith T.S. Pitted thin walled parenchyma	4	Bryony L.S. Sieve tubes	33
Brazil nut. Pitted and reticulate thickened parenchyma cells, isolated	5	Bryony T.S. Sieve tubes	34
Brazil nut. Prismatic cells from shell, isolated	6	Lime bark L.S. Sieve tubes	35
Rush T.S. Stellate parenchyma cells	7	Mazereon L.S. Spiral and pitted tracheides	36
Rush, isolated stellate parenchyma cells	8	Phlox. Anther. Stellate tissue of mesothecium	37
Vegetable Ivory T.S. Thickened unligified albumen cells. Pore canals	9	Crown Imperial. Anther. Fibro spiral tissue of mesothecium	38
Date stone L.S. Ditto	10	Crown Imperial. Anther T.S.	39
Coquilla nut T.S. Lignified parenchyma cells	11	Crown Imperial. Anther. Isolated cells	40
Coquilla nut, isolated lignified parenchyma cells	12	Hyacinth. Anther. Fibro spiral tissue. Raphides	41
Bullace stone, isolated lignified parenchyma cells	13	White water lily, peduncle T.S. Trichlobasts in air spaces	42
Star-anise testa, isolated lignified parenchyma cells	14	Water plantain, petiole T.S. Air spaces of aquatic plant	43
Star-anise testa, surface view, lignified parenchyma cells	15	Sowthistle stem T.S. Collenchyma	44
Walnut shell T.S. Lignified parenchyma cells	16	Onion. Bulb scale L.S. Laticiferous vessels	45
Pear T.S. Lignified parenchyma cells	17	Salsify. Root L.S. Laticiferous vessels	46
Pear, isolated. Lignified parenchyma cells	18	<i>Euphorbia splendens</i> . Stem L.S. Laticiferous vessels containing bone-shaped starch grains	47
Yew, isolated wood cells (tracheides). Spiral deposit	19	Oak. Bark T.S. Periderm, &c.	48
Yew, radial wood cells (tracheides). Spiral and pits	20	Red currant. Stem T.S. Phellogen	49
Cinchona bark (<i>C. Calisaya</i>) T.S., thickened bast cells, fusiform	21	Elder. Young shoot T.S. Phellogen, &c.	50
Cinchona bark, isolated bast cells, fusiform	22	Sugar cane T.S. Closed vascular bundles	51
Periwinkle, isolated bast cells, fusiform. Stratification of cell wall	23	Sugar cane L.S. Closed vascular bundles	52
Flax. Long fibre cells, isolated	24	Pampas grass T.S. Closed vascular bundles	53
Cotton. Hairs from seed vessel	25	Butcher's broom T.S. Closed vascular bundles	54
Rhubarb leaf. Spiral and annular vessels, isolated	26	Butcher's broom L.S. Closed vascular bundles	55
Brake fern. Scalariform vessels, isolated	27	<i>Ranunculus repens</i> . Runner T.S. Open collateral fibro vascular bundles	56
Brake fern L.S. Scalariform vessels, sieve tubes, &c.	28	<i>Aristolochia latifolia</i> T.S. Interfascicular cambium	57
Brake fern T.S. Scalariform vessels, sieve tubes, &c.	29	<i>Aristolochia latifolia</i> L.S. Interfascicular cambium	58
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	No.		No.
fer. Annual rings, turpentine passages	60	Orange. Leaf T.S. Crystals	93
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For prices of these selections see advertisement in this journal.

In many cases these objects have been stained, either singly or doubly, and some stained three years ago have not faded. Their very low cost commends them to every student of biology or collector of microscopic objects. They may be mounted in resinous media (damar, benzobalsam), glycerine, or glycerine jelly, the former being the easier for a beginner, while the latter, though more trouble, shows structure better.

In mounting, carefully separate the films, and remove the object. If for resinous media, soak in spirit of turpentine till clear, rinse in a fresh portion of the same, then drain, transfer to the slide, and finish as usual. For glycerine: If the object be oily, first wash out the oil with strong methylated spirit, transfer to glycerine and water, equal parts. Let it remain an hour or two, then mount. Minute objects, such as isolated cells, should be transferred on the point of a scalpel to a slide (or cover), and separated with a needle in a drop of spirit; then, if for glycerine, mount while still moist; but if for resinous media, allow to dry, then moisten with a drop of turpentine before applying the medium. Spiral and other vessels, and long fibre cells, which mat together, should be soaked in a drop of weak spirit, and a few of the most perfect picked out under a simple lens.

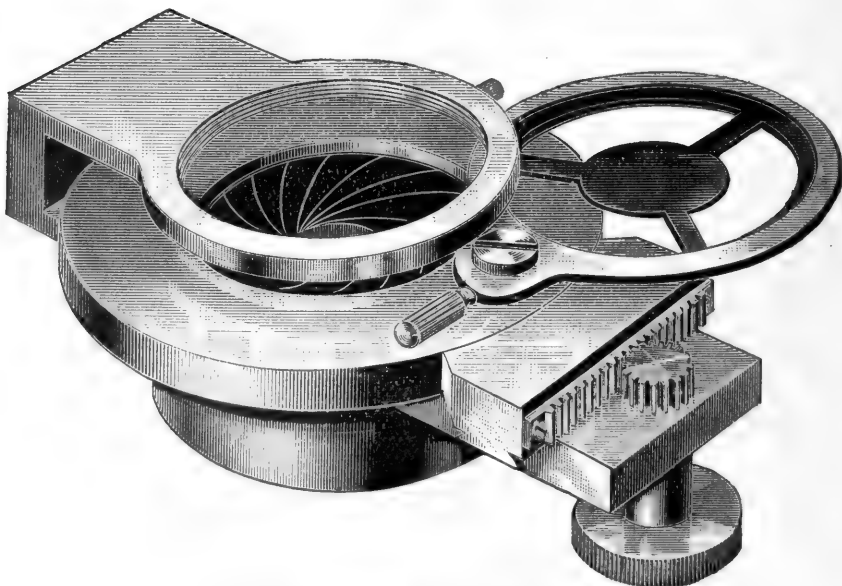
MICROSCOPICAL DIRECTORY AND STATISTICS.

During the Census year (1890) it is proposed to collect and publish in the *American Monthly Microscopical Journal* some statistics concerning Microscopy and the use of the microscope. Later, a directory will be published if sufficient encouragement is received. It is requested that the following questions be answered by every one to whom any of them apply. The answers will not be published in a way to expose any individual's personal affairs but will be compiled and used in totals. [Please number your answers from 1 to 17 to correspond with questions, and mail them to C. W. Smiley, Washington, D. C.]

1. Do you own a microscope?.....
2. What was its cost?.....
3. Of whose make is the stand and what pattern is it?.....
4. What objectives have you? What accessories?.....
5. How many mounts have you collected?.....
6. Do you wish to exchange mounts? What kinds?.....
7. To what extent did you use the microscope in 1889?.....
8. Of what microscopical periodicals have you files?.....
9. Have you ever engaged in photo-micrography?.....
10. Are you a teacher whose duties involve the use of the microscope?
If so, what chair in what institution?.....
11. If an "amateur" or student, what time and study did you devote
to the subject in 1889? Can you mount objects?.....
12. Are you in favor of or opposed to the present tariff on slides and
instruments?.....
13. What societies in your vicinity give attention to microscopy?
Give name of Secretary and his address?.....
14. What articles on microscopic subjects did you write in 1889?
Where were they published?.....
15. What physicians of your acquaintance own or use microscopes?.....
16. Give names and addresses of any other persons interested in mi-
croscopy.
17. Give your name, occupation, and address.



BAUSCH & LOMB'S BIOLOGICAL MICROSCOPE AND



CONDENSER MOUNTING.

THE AMERICAN MONTHLY MICROSCOPICAL JOURNAL.

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Some Recent Microscopical Apparatus.

By BAUSCH & LOMB,

ROCHESTER, N. Y.

In the microscope shown in the frontispiece, the construction of the Continental model developed by Hartnack, and now generally adopted by Leitz, Zeiss, and others, has been followed. There are embodied in it some improvements which have been considered important.

It is made of brass throughout, highly polished and lacquered. The base is of large dimensions, and, therefore, more firm, particularly when the body is inclined. The stage also is of large dimensions, thus allowing the use of culture slides without the danger of tilting. A groove is provided on its lower surface for the slide with cylinder diaphragms. This slide may be replaced by another, carrying a standard size substage, arranged to be centered, and provided with revolving diaphragm. To this may also be fitted any of the regular substage accessories. The main tube is provided with a draw-tube sliding in a special sheath, and when extended gives a total tube length of 170.0 millimeters. The biological series of objectives, especially computed for this instrument, are corrected for this tube length, and the medium and high power should be used with no other. In case it is desired to use the English standard tube length and Bausch & Lomb's regular objectives, the tubes may be extended by unscrewing the sheath and removing the screw-stop. The fine adjustment is by micrometer screw, and works on the triangular bearing of the arm.

The instrument is made in two forms: with solid pillar and arm, and with joint for inclination. These instruments are supplied with Continental eye-pieces, which, with the objectives $\frac{2}{3}$ and $\frac{1}{6}$, give a magnifying power from 45 to 485 diameters.

CONDENSER MOUNTING.—In the frontispiece is also shown a condenser mounting with iris diaphragm. This mounting provides a movement for the diaphragm by rack and pinion. It has in addition a recess

for receiving central stops and blue glass. This is, unquestionably, the most perfect mounting for controlling substage illumination.

It can be attached to an adjustable substage or to a substage fixed to the stage, and may be used with the high and low-angled Abbe condenser.

A Microscope Stand.*

By T. J. BURRILL, PH. D.,

CHAMPAIGN, ILL.

It is proposed to describe an instrument for general, practical work, for student and investigator, with nothing which can be omitted without detriment, and with no more expense than barely sufficient for the best accomplishment.

Of course, it will be understood that this is from the standpoint of a microscopist rather than that of a mechanician.

The foot must stand upon three points, and these should be shod with rubber. With the centre of gravity adjusted for it, the two projections are best directed backward, to prevent easy tipping when the tube is inclined. This disposes at once of the horseshoe base so generally used in continental Europe. In fact, the dismissal is too unceremonious, for with the small and short tube used on these instruments, and with the amount of metal in the foot, the danger mentioned is practically obviated. But it seems to me that the extra weight of the base is a cumbersome makeshift which ought to be avoided if practicable. In regard to the small tube, something will hereafter be said. As a further security of the instrument from tipping obliquely, sideways, and backward, the hind resting-point of the horseshoe-base is usually considerably extended sidewise. An excellent German stand, the most popular one in the country, has this rest one and seven-eighths inches wide, thus practically making four points in contact with the table—another fault in construction. But for an upright instrument, made as low as possible, with its centre of gravity well down towards the table, it is, after all, the best form. It allows the mirror to swing down to the table itself, and, with the conditions stated, the stand is sufficiently stable. Stability depends more upon the poise of the instrument than upon the weight of the foot. A heavy foot is of no advantage, aside from keeping the instrument from falling over, if other things are properly made. With rubber rests a very light stand does not easily slip on the smoothest surface, and such rests do vastly better service than several pounds of metal in preventing tremor communications.

In my ideal instrument I should, therefore, have a tripod base, with the single projection forward, and this flat and thin, so as not to seriously interfere with substage room, the whole simply heavy enough and broad enough for reasonable security, the weight being considerable less than half that usually put into the horseshoe form. There should be two supporting pillars rather than one, both for good appearance and the tendency to greater firmness, coupled with ease of movement of the compound body. This last should be easily regulated by a screw to control the friction. A stop should be provided by which the instrument may be *accurately* brought to the horizontal.

*Abstracted from the Proceedings of the American Society of Microscopists, volume xi.

The base and pillars may be of iron, cast in one piece and japanned. This is not entirely on the score of economy. It is not essential in the instrument in mind that there should be any movement of the supporting columns on the base. I should not try to have the foot so fixed as to put either forward. The japanned surface is more durable than any lacquer, and certainly better in appearance after some years of wear than most brass work under similar usage. But economy in a part like this is commendable, detracting nothing whatever from the best service of the instrument, but, as just said, rather increasing it.

My instrument should have a joint for inclination. One of the first maxims by which a careful worker should be guided is: "Make yourself comfortable." Why should I try to educate myself into awkwardness and discomfort to accommodate a faulty instrument? I believe it is seriously improper to train beginners to work only over a vertical tube. We all know what habits are and how easily bad ones take hold upon us, especially when we are young and beginning new service. To be sure, some work requires an erect instrument; but with the joint this is secured at will, and without detriment in any way beyond a very slight additional expense.

The mirrors—plane and concave—must be adjustable for focusing on an arm swinging upon an axis level with the object and capable of rising above the stage. I do not regard this last of the same degree of importance as the inclining joint, for there are other ways of securing the desired illumination aside from the central beam, which is the one with which all mostly work, except as specialists. Still, this American "tail-piece," as some foreign manufacturers call it, is so simple in construction and so acceptable when needed that we cannot afford to dispense with it. It ought to be graduated to show the angle at which it is placed. We must have some fitting for substage illumination. No worker with a microscope, certainly none in college classes, ought to be ignorant of the use of the modern condensers. Certainly our ideal stands must be constructed to permit their attachment. It very often happens that a low-power objective can be used with the greatest advantage as a condenser; hence for this reason our fitting ought to be readily adapted to it. To get the best results the condenser must be very accurately centred, which I have never been able to satisfactorily accomplish without setting-screws. The screw-clamp is not sufficiently manageable.

The stage should be as low as consistent with needed room below, but this last must not be trespassed upon for any consideration whatever. Four and a half inches from the table is a convenient height, and probably allows all necessary room below. A half-inch lower would be preferred by some, while I should not object to a fourth or even a half-inch higher, if the facilities of illumination required it. Three and a half inches is sufficiently wide, and the circular form is desirable. Above all things, the stage must be very firm, so strongly fashioned and supported that no ordinary pressure of the hand will affect it. To secure this rigidity, the method of construction, instead of great thickness, must be appealed to. Indeed, with a strong rim the plate can be quite thin, and is better so made, aside from its advantage in the use of very oblique light. The stage need only be furnished with a pair of delicate clips. These should be watch-spring steel or something as

good. The heavy, stiff abominations, sometimes furnished with even high-priced instruments, ought not to be tolerated by any buyer. A glass sliding stage, of simple construction, is a real convenience, much said to the contrary notwithstanding. One can make with its aid the minute movements often required with greater ease and certainty, especially with one hand, than by manipulating the slide itself. But I should make this so that it can be instantly removed or left off altogether if the buyer so preferred. A mechanical stage need only be used in special work, but as it is essential in photography with high-power objectives, and in work requiring much careful searching of a field where only high powers suffice, it is desirable to have it possible to readily attach the mechanism to the common stage. I prefer the form by which the 3×1 inch slide is simply grasped at the ends, allowing it to lie flat on the surface of the plain stage; the preference is mainly from the simplicity and cheapness. But a mechanical stage is a delusion, an intolerable vexation, if the movements are not smooth and under exact and easy control. Better have none at all than one that jumps, now refuses to go, and now goes too far. If worth having, it is worth graduating to facilitate refinding a desired object. In any event, it must be easily removable, leaving the plain stage readily accessible.

The arm (Jackson model) must support the tube along the side, and should be so fashioned as to make a convenient handle, by which the instrument is grasped when moved. This last is a very minor consideration, but really worth attention. For myself, I should prefer to have this also of japanned iron, gracefully curved and rounded. Here especially, sharp angles, the pride of brass-filers, are objectionable in use, and are exceedingly liable to become the worse in appearance from wear.

The fine adjustment must be thoroughly perfect in action. This must be made emphatic beyond everything else. The movement must be easy, absolutely prompt, rigidly free from lateral displacement, and with as much range as possible; in any case not less than an eighth of an inch. The position of the milled head controlling the screw is a matter of much more moment than commonly thought. It is more essential that this be low than it is that the stage be so placed. To reach up under one's chin for the milled head is annoying. The less the distance from the stage to the milled head of the fine adjustment the better, for the hand is so frequently passed from one to the other that no obstacle should be permitted to interfere with the movement. This milled head must be equally accessible to either hand, and in every way the most conveniently handled of any part of the instrument. It should also be graduated with degree marks, though it cannot be said to be essential that these should be numbered. The motion must apply to the whole tube. Nothing else can be considered ideal, whatever may be said of nose-pieces and stage movements.

A rack and pinion, or something equally good, should be considered essential for the coarse adjustment. To be sure, one can manage a tube slipping in a sleeve; but I will stick to the rack and pinion with two good-sized milled heads, unless something better is offered. With good workmanship this movement is perfectly smooth, with no back-lash. Oblique teeth, used by some manufacturers, seem to be advantageous.

We come now to the mooted question of the size and length of the tube. There are two advantages of the larger tubes which must be

recognized, whether or not we admit others. In the first place, these tubes permit the use of diaphragms to cut off the injurious reflection from the sides. It is impossible to blacken the inner surface of the tube so that there shall be no reflected light, and the usual attempts at this are dangerous to objectives, because the crumbling particles fall on to the back lens to an exceedingly injurious extent. Hundreds of workers over the tube have no conception of the state of their objectives in this particular. If they did it would often be so much the worse for the objectives, for the attempts to clean them would frequently injure more than cure. With metal diaphragms, properly placed and shaped, the unused light can be thoroughly intercepted. At the same time a safeguard instead of a danger is provided for the optical parts. Again, larger tubes make it possible to use larger field lenses with low-power eye-pieces, a thing of no mean importance. This, however, depends somewhat upon the length, because the longer the tube the wider the upper end may be with advantage.

In regard to the length, I cannot but feel that too little attention is usually given by those who use the instrument to the proper adjustment for the objectives employed. If these are without collar corrections and are made for a ten-inch tube with cover-glass of a definite thickness, then the best work cannot be expected of them with any other length, if the same kind of eye-piece is used. Whatever else is sacrificed this best work should always be secured. There is nothing that can compensate for impairment of the best possible image from the objective. The microscopist must know what that best image is, and must know how to secure it or he fails in an important element. The special length of tube for the special objective becomes, therefore, a practical consideration of transcendent import. Draw-tubes are of great service if intelligently managed, but otherwise may easily be the source of much unsuspected mischief. It is well known that English and American objectives, as well as some others, are constructed for a ten-inch tube. For these, under usual circumstances, there is no alternative as to length of tube for the stand, unless, indeed, an eye-piece is especially adapted to the changed conditions. Beginners especially ought to recognize this imperative condition of things. Of course the same reasoning holds good in regard to objectives and tubes of shorter working. With an objective constructed for a tube length of one hundred and sixty millimeters this latter length should be used and no other, except as modifications are made by collar adjustment, thickness of cover, peculiarity of eye-piece, and the like.

So far there is no choice offered; but if it is a question of convenience or of merit between a six-inch and a ten-inch tube, before purchasing either stands or objectives, then there is a chance for selection. So far as the optical question is concerned, there can be no great difference, or we should have long ago heard more of it from those who have made these matters a special study. Of course the curvatures of the lenses must be increased for the short tube to furnish the same magnification. In other words, those who work with short tubes must use objectives or eye-pieces of somewhat greater power to secure the enlargement obtained with the longer combination. In my experience the higher the power of the eye-piece the more fatigue to the eye in prolonged work, and certainly the higher the power of the objective

the greater the necessity of having all adjustments from the illuminating mirror to the eye exactly correct. An advantage of large field lenses in low-power eye-pieces and with long tubes has been previously mentioned. It therefore appears to me, from the standpoint of optical performance, the long tubes do have some advantage over those of shorter length. The only other question is that of convenience. If an instrument is to be used in an upright position continually, I have no hesitation in saying that the shorter form is easier to work with. This carries us back to a topic, already discussed, in which I am fully aware the majority of biologists are against me. But I am by no means alone in the advocacy of an inclined stand. As a rule, I find the students in laboratories supplied with instruments made with a joint, using them for the most part inclined, unless the table is too low to conveniently permit it. I have very seldom found it necessary to work with a vertical tube. With low power work in zoölogy the case is certainly different; but in any careful study of slides even in zoölogy the worker may, and I think should, tip the instrument and sit as nearly upright as practicable, the table being of the most convenient height for ordinary writing.

Both in theory and practice it will be seen I give the preference for this general purpose stand to the long tube, or rather, perhaps, to one that can be very easily drawn to the ten-inch length, using dimensions adapted to this dimension. Taking all in all, American-made stands suit me better than those of foreign construction, though we of the guild will hardly admit there is no room for improvement.

In the discussion which followed, Professor Kellicott agreed in the main with the conclusions of the paper. He thought a stand should be used in the inclined position, when practicable, but would make much allowance for habit. He prefers the ten-inch tube, and commends the placing of the diaphragms so as to catch any particles of falling dirt. Has used and rather prefers a square stage.

J. D. Hyatt would prefer a circular concentrically revolving stage, and for some work it is a necessity, as in lithological studies. Has found it difficult to get a concentric stage truly centred and to keep it so.

Prof. W. A. Rogers emphasized the value of the rack and pinion. He said he would much rather do without the slow motion than without this, for a good rack and pinion can be made to answer both purposes.

W. H. Walmsley also commended the rack and pinion, but would have the milled heads two and a half inches in diameter. Fine adjustment must move the whole body; a nose-piece movement must be considered obsolete. He would prefer a circular stage, as being easier made and better. He thinks it can be truly concentric in movement.

Dr. Geo. E. Fell said: In some work, as in the examination of legal documents, a large stand or stage is a great convenience. When mechanical appliances can be made really serviceable, they should be used. Slow motion is of value, and especially necessary for beginners.

Mr. Geo. S. Woolman would have medium length of tube, and adjust with a draw tube. He thinks all should know about Abbe's sub-stage condenser, and other forms, and thinks it important that these condensers should have a rack and pinion adjustment. There is no harm in having a little play in rack and pinion.

As regards the necessity of a joint and the natural tendency of beginners to work with the instrument in its inclined position, Dr. James cited an incident in his own experience. Some of his students purchased cheap German stands unprovided with a joint. After working with his instrument a few days one of the boys came to him one morning with a couple of boards ten inches square, hinged together on one side, so as to permit the upper one to be set at any desired angle, and to be used for a foot to the instrument. In a week every student had a similar arrangement, and worked with the instrument inclined.

Dr. R. H. Ward explained what he saw in the laboratories of Continental Europe. As each of these is organized by a professor, there are many personal preferences and local ideas brought out. Students who work in the laboratories come to this country knowing no other instruments, and are likely to continue the use of the same. European students are loyal to their own dealers. Usually the makers supply what is called for. A joint for inclination should be considered essential. Round stages are equal in every way to the square, and have some advantages, as for rotation, the second stage being more easily adjusted.

Dr. L. D. McIntosh said that makers cater to the requirements of trade. They could not sell instruments without a joint, and so do not make them. Round stages are more easily made than square ones. American instruments are certainly superior to those of foreign manufacture.

Cleaning Diatoms.*

By EDWARD S. NOTT,

HAMBURG, N. Y.

1. The material must be completely disintegrated by continued boiling in a solution of sal soda.

2. The disintegrated material should be sifted in a sieve made of bolt-cloth, removing all the fine earths and broken forms.

3. The remainder may have the greater part of the sand removed from it by revolving it in an evaporating dish with water.

4. The material, now mostly diatoms, should be boiled in acids. First, in muriatic, then wash; second, in nitric, then wash, and sometimes boil also in sulphuric acid.

5. After washing all traces of acid away, boil once more in a solution of sal soda, wash and sift in a fine sieve of bolt-cloth.

The object is to remove all the debris and waste material before using the acids, as the result will be better and at a less expenditure of time and labor. The stock should be kept in alcohol, and in mounting, the best distilled water should be used.

—o—

We desire to return thanks to Dr. Edward Gray, of Benicia, California, for the following interesting specimen: Seeds of *Orthocarpus purpurascens*, a description of which will be found in the Doctor's paper published in the June, 1885, number of this JOURNAL.

Notes on the Fossil Marine Diatom Deposit from Artesian Wells at Atlantic City, N. J.

By C. L. PETICOLAS.

RICHMOND, VA.

Several interesting articles upon this subject, with illustrations of new species of diatoms found, have appeared in the Bulletin of the Torrey Botanical Club—the joint contribution of Messrs. C. H. Kain and E. A. Schultze. Through the courtesy of Mr. Lewis Woolman, the discoverer of this extraordinary deposit, who will shortly give an elaborate report on the Geology and Paleontology of these Artesian Wells, I have been enabled to make a somewhat comprehensive examination of this field, during the past year, and the facts developed are of such an interesting character that some additional notes may not be out of place.

It was at first supposed that the deposit lay in series of strata of varying thickness separated by thick beds of clay and sand, showing no diatoms, but a careful examination of some of the most unpromising material has led to the belief that we here have an almost continuous bed of diatomaceous earth, which may be stated, in round numbers, to be 300 feet thick, interrupted in a few places by thin beds of a fine white sand similar to what is deposited with the diatoms, more or less, all the way through. An examination of any rich diatomaceous earth shows that these deposits are not continuous, but periodical with the seasons. The spring and fall being the most favorable times for their growth, we may justly infer that the laminæ of about the $\frac{1}{80}$ th of an inch into which these deposits separate in being first broken down, are the growth of a single season. Twenty years would therefore seem to be a moderate allowance of time for the accumulation of one inch in thickness of strata, and this will, at all events, give us an approximate idea of the enormous lapse of time since these formations were begun. We have been accustomed to view with wonder the diatomaceous strata at Richmond, Petersburg, Nottingham, and other points, some 30 or 40 feet thick, and requiring perhaps 10,000 years for their deposit, but here is a bed of diatoms 300 feet thick, which, upon the same calculation, must have taken 100,000 years to complete. The time required for the deposition of the 400 feet of non-diatomaceous materials which overlie this deposit must also have been very great. The diatoms first appear at the depth of 382 feet, and the last showings are obtained at 677 feet.

Throughout the whole deposit certain forms such as *Orthosira marina* and several species of *Coscinodiscus* are constant, but other species vary continually at the various points examined, the appearance and extinction of the different forms bearing a striking analogy to the rise and fall of species in the animal kingdom, or of empires and states in the political world. A number of new species have already been noted and classified, but there are without doubt many more yet to be determined, as at certain points almost every mount shows strange forms, and curiously enough, some of the earth poorest in forms has shown the largest percentage of novelties. At the lowest levels but few diatoms have been found, but at 625 feet the diatoms are abundant and just here the *Actinocyclus* seem to reach their point of greatest develop-

ment and beauty—slides from this level appear like prairies thickly strewn with flowers of the most varied and brilliant colors. At 550 feet the deposit is much richer in species, several varieties of *Aulacodiscus crux* and *A. solitarius* being specially abundant and beautiful.

The culmination of the deposit seems to have occurred at about 466 to 480 feet; at this point the forms are shown in endless variety, from the largest and most robust down to the most minute, many of which do not exceed $\frac{1}{3000}$ of an inch in diameter. A peculiarly interesting feature of this part of the deposit is that here are found all the characteristic forms which occur in the artesian material from Cambridge, Md., which was found 300 feet from the surface, as well as the characteristic forms found in the Eighth street tunnel cutting at Richmond, Va., which occurred at a depth of about 50 feet from the surface. At 466 feet the curious and beautiful *N. disciformis* is much more abundant than in the Cambridge well. *Tr. spinosum* is found at this point, with a singular variation, as a four-sided form, an Amphitetras in fact, also *Tr. pentacrinus* and many beautiful species of *Asteromphalus*, some of them similar to those found at the Island of Java. Of the many novelties noted at this level a more detailed account may be given hereafter. Above this point a gradual diminution of the number of species takes place until at 382 feet only a few *Orthosira* and common *coscinodiscii* are shown. Careful and scrupulously separate preparations have been made from the following levels, viz: 382 feet, 390 feet, 400 feet, 406 feet, 415 feet, 425 feet, 466 feet, 480 feet, 500 feet, 510 feet, 525 feet, 550 feet, 625 feet, 638 feet. Several of these are divided into two densities and one, the 466 feet, into three, for convenience of examination. A good $\frac{1}{2}$ -inch objective gives very satisfactory views of the larger forms, while for the smallest a $\frac{1}{8}$ or $\frac{1}{10}$ and about 1,000 linear magnification are desirable. Here, then, in our own matter-of-fact and prosaic Nineteenth Century we have a realization of the fancies of the old Arabian story-teller who conducts his hero to a subterranean garden, sparkling with gems of every variety of form and color. More fortunate than Aladdin we are not left under ground at the mercy of the Genii, but have brought up our treasures in safety and opened them out for the admiration and delight of the world.

Report upon the Postal Club Boxes.—X.

By QUEEN MAB.

Box A contains several slides of unusual interest. This is due in no small degree to the fullness of the descriptions which accompany them. No. 1 is contributed by R. H. Ward, of Troy, N. Y., a Bell Hydroid, an undetermined species of *Campanularia*, mounted in balsam, in a block-tin cell, which is finished with Bell's cement. A 3-in. objective is recommended for a general view, and for details, $\frac{2}{3}$ – $\frac{3}{4}$. Cape Ann was the source of this hydroid, and it was killed with tentacles expanded by the use of picro-sulphuric acid. It has been Mr. Ward's experience that this particular hydroid can be killed in a more perfect condition by this reagent than by any other, though some hydroids, as *Tubularia*, can be best killed by a saturated solution of corrosive sublimate in alcohol. If a colony of *Campanularia*, when brought in from a collecting

excursion be placed in a vial of fresh, cool, clear sea-water, not much larger than the colony, and be carefully watched until the tentacles of the zoöides project well, the immediate application of a dropping tube full of picro-sulphuric acid will kill them with tentacles expanded and in natural position. The description is accompanied with a drawing, showing Hydrauth, Hydrotheka, etc.

No. 4, by Dr. A. M. Wright, of Troy, is a fine large section of Oolite, or Roestone, from Princeton, Ky., mounted in balsam.

No. 5 is a section of the stem of clover with its parasitic dodder, by Joseph McKay, of Troy. "The dodder is a leafless twining plant, resembling fine wet catgut, and this species does great injury at times to clover fields. The seeds germinate in the ground, and the young stem coming in contact with the living stem of the clover plant, throws out a sucker which penetrates and commences to absorb the sap from its host. As the plant grows fresh suckers are thrown out, and the original root in the ground dies and drops off."

No. 6, by Frank Richie, Troy, leaf bud of basswood, unbleached section, longitudinally through young stem, bud, and base of leaf stem. It is mounted in spruce gum in alcohol, and the cements used are shellac and Prince's metallic paint, finished with hard oil. This slide also is accompanied with a drawing.

Box bx 1.—This is an installment of the Cole Studies. Sufficient care has not been bestowed on paging the accompanying text, and the consequent confusion detracts from the interest of the studies.

Slide 1 is "Root of Dock." After quoting from Thomè and McNab as to the functions of both the higher and lower plants, plant roots are described. The root of a plant is an organ growing downward into the soil, whose apex is protected by a root cap, and whose function is to anchor the plant and absorb nourishment for it from the surrounding soil. Roots are of two kinds, the true roots, which are formed from the downward growth of the radicle of the embryo, and adventitious roots, which always arise from the outside of the woody ring, and, bursting through the cortex, escape. In length, roots grow by a mass of living cells at their tips; in thickness, by a layer of cambium. Roots vary in their mode of growth and functions: some roots function as reservoirs of nutrition, as those of our succulent vegetables. Orchids sometimes form both aerial and tuberous roots, the former acting as organs of absorption, and the latter as reservoirs of nutrition.

As to the microscopical characteristics of roots. "In young roots, just behind the tip, the wood and bast are arranged in different radii with a cambium layer between them; as new wood and new bast are formed, the former is driven inward toward the comparatively more rapid growth of the cambium, whilst by the same agency the bast is pushed out toward the circumference." The bitter root of the dock being strongly impregnated with sulphur, is a powerful anti-scorbutic.

Slide No. 2 shows "Hæmorrhagic Infarction in kidney of Infant," and though no doubt of value to the medical members, possesses little interest for the general student.

A Search for Diatoms in Boston Harbor, in September, 1889.

By WILLIAM A. TERRY,

BRISTOL, CONN.

Having long wished for an opportunity to collect in Boston Harbor, I took advantage of a summer excursion, and packing my dredging apparatus in a basket started off. Leaving the steamer at Pemberton we hired a row-boat and commenced dredging, working between Pemberton and Hull on both sides, and through the steamboat channel, and out into the deeper water near the Gut of Hull.

The eel grass was rather troublesome and the bottom hard. In the deep water the tidal currents, running in opposite directions, made it difficult to manage the dredge, but after two hours hard labor we had gathered sufficient material to answer the purpose, and started on foot to explore the outer beach. Pemberton Hotel is at the point of a long and narrow tongue of land about five miles in length. The extremity is hilly, but about three and a half miles of the lower end is a low sand-bar not over thirty or forty rods in width, covered with cottages, hotels, and all the usual accompaniments of a summer resort. A railroad of some eight miles in length runs trains every few minutes during the summer to the various hotels and over the mainland to the Old Colony road.

We found the outer beach above the cove to be composed of boulders covered with rockweed, *Fucus vesiculosus* and *F. nodosus*; beyond this in deeper water was *Chondrus crispus*, and deeper still might probably have been found the home of the red algæ; but as we saw none to day we passed on, finding a few specimens of *Cladophora gracilis* and several large bright green mats of *Chaetomorpha tortuosa*, whose moniliform threads are so closely matted and interwoven that I have never been able to separate them successfully so as to find their actual length.

Seeing nothing else of interest we went on to the cove at the upper end of Nantasket Beach, which I was surprised to find entirely bare, although at a former visit I had found it loaded with sea-weed. And here may I be pardoned for a digression to relate some incidents of that former visit, as it illustrates some of the tribulations of a collector. I had started for Nahant, but finding the boat had been taken off the previous day I hurried to the Nantasket landing just in time to catch the boat as it was leaving. After starting I made inquiries and found this was the last trip of the boat for the season, and that it would not return, leaving me stranded sixteen miles from the city with the hotels all closed, the railroad depot locked up and barricaded with rails, and no one around who appeared to know anything. However, collecting was my object, and I started on the weary tramp over three and a half miles of sand to the cove. Here I found an immense deposit of sea-weed, which I estimated at hundreds, perhaps thousands of tons, consisting of the great *Laminaria*, the sea colendar, with *Laminaria longicruris*, *Laminaria digitata*, *Chorda filum*, *Rhodomenia palmata* and small fronds of *Delesseria sinuosa* and *Ptilota serrata*. Unfortunately these, although evidently young, were not brilliant in color.

Returning, I got in at one of the deserted hotels by promising not to call for anything to eat. I did, however, manage to get a slice of bread

and cup of tea. In the morning, after exploring the beach for some miles, I started to walk over the three miles of railroad track to the Old Colony depot. Before arriving there I met with a crossing keeper, who informed me that if I had waited half an hour I might have come on the train, as the law obliged the company to run one train a day through the winter. While he was telling this the train passed, and he said the Old Colony train would be due in ten minutes. I hurried on, but in less than a minute heard the whistle of the approaching train, and arrived at the depot only in time to see it receding in the distance. The depot was entirely deserted, but looking around I found a man who told me the time-table had been changed that morning and the train was ten minutes earlier than before, and the next train was not due for four hours.

Having walked upwards of ten miles, lugging a heavy basket, I did not feel much like exploring further, and passed the time as best I could until the hour for the train, when I entered the empty depot and sat down. In a few minutes a benevolent individual opened the door and asked if I was waiting for the train, and informed me that there were none that stopped at that depot, except the one I had missed, but that if I wished to go on I might flag the train myself, which, with many thanks to him, I most promptly did, and was soon on my way home, musing on the exigencies of autumn travel at a summer resort.

But to return, although the beach was bare there was a quantity of yellow, olive, brown, and black algæ swashing up and down in the tide ripples, from which I fished out a few fronds of *Euthora cristata* and *Delesseria sinuosa*, the latter covered with the usual animal incrustations. I have never succeeded in finding any diatoms on any of these algæ. We noted the great numbers of small starfish tumbling in the tide ripples; they might have been picked up by the peck; very few of them over two inches in diameter—a discouraging outlook for the success of oyster culture in this vicinity.

Reaching Nantasket we were disappointed to find that no row-boats could be procured in the lower part of the harbor. Being now late we gave up for the night, intending to take an early start in the morning, but the morning brought a pouring rain and we started on the tiresome ride for home, a distance of nearly one hundred and fifty miles, looking regretfully as we passed at the coves and inlets where I had hoped to find interesting, if not new, varieties. I found the mud gathered at Pemberton not very rich, but containing quite a quantity of *Pleurosigma balticum* and the small form resembling *P. formosum* I have before noticed at Morris Cove. I was pleased to find a number of large and fine specimens of the typical *P. formosum*, some of them the largest *Pleurosigma* I had ever seen, so large that the largest *P. balticum* looked dwarfed beside them. But the most characteristic variety were fine specimens of *Stauroptera aspera*, the finest I had ever seen in sufficient quantity to name the gathering. Next in number was *Navicula longa*, then fine specimens of several varieties of *N. constricta*, *N. eliptica*, *N. lyra*, and many others, a few *Coscinodiscus*, *Actinopterychus*, *Campylodiscus*, *Triceratium*, *Glyphodesmus*, several varieties of *Biddulphia*, *Rhabdonema*, *Melosira*, *Cerataulus*, *Actinocyclus dubius*, *Achnanthes longipes*, *Bacillaria paradoxa*, *Synedra superba*, *Suriella ovata*, *Nitzschia curvula*, *Hyalodiscus subtilis*, *Pleurosigma*

fasciola, and several other small varieties I cannot name. *P. angulatum* appears to be absent from Boston harbor, while it is plentiful on the Connecticut shore.

But the variety that most surprised me was a species I supposed foreign to our northeast shores. After washing off the lighter diatoms I took a drop containing sand, coal-dust, &c., and examined it with low power and counted twenty-seven entire frustules of *Isthmia nervosa* in one drop. I had previously found fragments and sometimes a valve in my Connecticut shore gatherings, but supposed them accidental, brought from long distances by storms. In cleaning California specimens I have found the valves separate easily in the acid, but these, although much more severely treated, remained nearly all entire. This harbor-mud contains quantities of cinders, coal-dust, and ashes from the steamers and is hard to clean. I would like to hear from collectors as to whether *Isthmia nervosa* is found living on our Atlantic shores.

Marl from Fort Washington, Md.*

BY PROF. RICHARD FOSTER,
WASHINGTON, D. C.

The Eocene Tertiary formation crops out ten miles below the city of Washington, at Fort Washington, on the banks of the Potomac. This formation runs about parallel with the coast, and is seen on the surface again in New Jersey, and there contains the noted marl beds of that State. Marl is found at many localities in this formation, and at different places it differs considerably in composition. That which I have had tested from Fort Washington contains large quantities of carbonate of lime, phosphate of lime, and sand, and traces of potash, iron, and magnesia. In 1860, Philip T. Tyson, then chemist of Maryland, made several assays of this marl with the following results. From a specimen obtained from the southern corner of the District of Columbia, he obtained: carbonate of lime, 26.5; carbonate of magnesia, 2.7; silica, 42.4; silicate of alumina and iron, 25.4; potash, 20.0; water, 1.0.

From a sample from Port Tobacco, he obtained the following: silica, 55.73; protoxide of iron, 9.45; alumina, 5.45; carbonate of lime, 12.92; potash, 2.07; water, 9.90.

From samples taken near Fort Washington, the following analysis was made: sand, 75.72; organic matter, 1.79; carbonate of lime, 5.32; phosphate of iron, .44; alumina and oxide of iron, 14.77; potash, 2.53.

From a large number of assays of the New Jersey marl compared with a number of assays of Fort Washington marl, I obtain the following comparison:

New Jersey Marls. Fort Washington Marls.

Silica.....	50	50 to 75
Alumina	6 to 7	5 " 14.44
Oxide of iron.....	21 " 22	9 " 14
Potash ...	9 " 14	traces " 3
Carbonate of lime.....	1 " 3	5 " 27
Water, etc.	7 " 9	2 " 9

* Read before the Washington Microscopical Society, Feb. 12, 1889.

By this comparison it is seen that the New Jersey marl is richer in potash and oxide of iron, while the Fort Washington marl is richer in carbonate of lime. The land in Virginia and Maryland was about the first in America to come under cultivation, and many farms in this vicinity and around Baltimore have been tilled for about two hundred years. In the Northern States a systematic plan has been adopted for enriching the soil, but no such plan has been adopted in Maryland or Virginia to any great extent. We have here, however, at our very doors the material to bring back to the soil the strength which has been squandered during the many years of constantly taking from the soil and putting nothing back in return.

The marl beds of this locality are much more easily worked than those of New Jersey, and the material is as well calculated to enrich this soil as the New Jersey marl is to enrich that soil. The marl from Fort Washington can be put on the field at a cost of 5 cents per bushel, while in New Jersey, twelve or fifteen cents per bushel is often paid for it by the farmer.

The microscopical examination of this marl reveals its great value at once. Bits of shell can be seen all through the sand. Each particle of sand is covered by a fine green coat, which is probably vivinite. When heated it changes its color from a light to a very dark green. The soluble portions of the marl are rapidly lost by exposure to the weather, and so that which comes from deep down in the pit is much better than that from near the surface. When it is placed upon the field it should be lightly covered by the harrow and left for the snows and rains of winter to disintegrate the mass and mix the soluble portions with the soil. Thus we see that the farmers of this region have at their very doors a rich fertilizer, which is cheap and abundant and easily procured.

As soon as its value is appreciated, as it now is in other parts of our land, it is sure to revolutionize agriculture. The farming district about Washington is one of the poorest in the United States, and in many places farms are cheaper now than they were fifty years ago. I know of a farm of 40 acres within eighteen miles of Washington, which can be had for four hundred dollars, and that is about the average price per acre for these worn-out fields. If, however, this natural fertilizer should come into general use as it deserves, we would see all this changed, and instead of the red and yellow clay hills, the tumble-down shanties and general appearance of desolation which now confronts one on all sides in the rural districts, would be rich fields, handsome farm-houses, and well-filled granaries.

Dr. Seaman said: The marl formations of New Jersey have peculiar features, possessed by no others. They are unique in the large amount of potash they contain. Large quantities of sharks' teeth are found, but no diatoms.

The method of digging the marl was then described, and also the marl deposits on James river in Virginia.

Prof. Foster said: While the Maryland marl is poor in potash, yet it is equally true that the soil of Maryland and Virginia needs not so much potash as carbonate of lime, and this the Maryland marl has.

MEDICAL MICROSCOPY.

By F. BLANCHARD, M. D.,

PEACHAM, VT.

The Positive Diagnosis of Syphilis.—A drop of blood just large enough to fill the space between an ordinary cover-glass and an ordinary slide, is obtained by puncture on the radial side of the wrist. The slide is immediately transferred to the stage of a good microscope.

If the light is properly adjusted, and the observer is sincere and competent, as the syphilitic blood goes through its biological movements in dying, there will be seen here and there, more or less numerous active, automobile, sometimes saltatory, extremely minute globular bodies, the spores of *Crypta syphilitica*, which, when dancing or put slightly out of focus, are copper-colored. The higher the power, the more distinct this color. With the $\frac{1}{15}$ -inch objective of Tolles, the copper color has been found more marked than with any other power.

Sometimes these spores will travel across the whole field. They are found in the serum spaces, over the red corpuscles, and in the white corpuscles. In old cases they are found in the urine and especially in the pus of chancres. These spores are the baby stage of *Crypta syphilitica* (Salisbury). The fully developed form or parent plant is a cylindrical filament, slightly tapering, and is found in the blood in the form of short curved segments, sometimes slightly clavate at one end and in long strings or filaments, in coils, skeins, or comparatively straight. In the walls of chancres they are very curling and spirally twisted, like the vegetable filaments of the plant in carbuncle. These *Crypta syphilitica* filaments are also copper-colored when put a little out of focus. The mature plant is not as common as the infantile, which has the power of reproduction in its immature stage and of producing the physical and chemical influences of the mature plant.

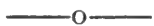
The spores are to be distinguished from minute globules of fat. Fat globules do not travel across the field save in currents of capillarity, in which everything moves with them, nor do they travel in opposite directions as syphilitic spores do. In the present stage of knowledge the spores of syphilis are unique in their active, saltatory motions, and copper color.

In a late trial for murder, the suspect's clothes were submitted to the writer, apparently stained with blood, which had been more or less marked by water. In the study of the morphology of this clothing, a list was made of the objects found under the microscope along with with the blood—as a matter of detail—not intending to use the foreign bodies as testimony. But the counsel for the defence in his cross-examination told the judge that he would show that I was not an expert, and that I knew nothing about the subject. He then asked, "What did you find in your examination?" Thus challenged, the list was partially read, embracing a variety of objects. In the list was included syphilitic spores in active motion and enlarged white blood corpuscles, which enclosed syphilitic spores. These attracted attention in and out of the court-room.

Subsequently the physician of the murdered man testified that he was treating him for syphilis at the time of the murder. The jury hung—ten for conviction and two for acquittal. Just before the second

trial a physician brought me a slide with blood, which he said was taken from a patient who, he thought, had syphilis. I found the spores in active motion. At the trial this same physician was called to the stand, but was non-committal and got away as soon as he could. I was then shown the slide that he had brought to me, and on being questioned testified that I had found the evidence of syphilitic blood in it. It then transpired that a trap had been laid for me, for the blood in the slide was obtained from the prisoner. Still, my evidence was positive, for a physician testified that he had treated him for syphilis. This time the suspect was convicted and sentenced for life. [Ephraim Cutter, M. D., a paper read at the meeting of the American Medical Association, June, 1889.]

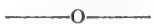
In the discussion following the reading of Dr. Cutter's paper, the trend of opinion was that the observed globular bodies were broken up blood corpuscles, and not microbic spores.



"The Mechanism of Immunity."—In a recent number of the *British Medical Journal*, Mr. E. H. Hankin publishes that he has prepared from cultures of anthrax an albumose which, when injected into mice or rabbits, protects these animals against the action of the anthrax bacillus. This goes to support the theory that the agent of immunity is a chemical substance—a by-product of microbic growth. Granted this, and the step to chemical synthesis of the protective agent is a short one.



Prof. H. N. Lyon.—Recognizing that the study of pathology cannot be profitably pursued until a knowledge of the tissues in health has been obtained, the Hahnemann Medical College offers especial advantages in its department of Histology and Microscopy. In addition to hearing the didactic lectures, the student has opportunity of becoming familiar with the use of the microscope and with micro-histological methods, by practical work in the laboratory. Dr. Lyon occupies the chair adjunct to the chair of Histology and demonstrator of Histology and Microscopy.



Tuberculosis and Butcher's Meat.—The *Nineteenth Century* for September, 1889, contains an article by Henry Behrend, a Hebrew physician of London, relating to the Hebrew method of butchering and inspecting meat. If the statements therein made are facts, they show (1) the great advantage of rigid meat inspections as a means of preventing tuberculosis; (2) an alarming proportion of diseased animals; and (3) an equally alarming lack of altruism in the Hebrew race as regards other races.

We quote a few of the statements: "Of 13,116 beeves slaughtered for the Hebrew trade in London in six months, only 6,973 were deemed fit for Jewish use." "The average rejections for five years have been forty per cent. But these rejections are often sold to the Gentiles for food." "In a large practice of over thirty years he has never met a case of consumption in a Jew, and other busy physicians make similar statements."

NOTES.

The January number of the *American Naturalist* comes promptly to hand from the new publishers, Ferris Bros., Philadelphia. Notwithstanding the very unfortunate arrearages of 1889, three numbers of which are still due, those for 1890 are promised with regularity. The missing numbers for last year will also be issued as rapidly as possible. With such assurances from the publishers, we think it safe for our friends to co-operate in supporting this scientific periodical. Its price is \$4.00 per year, but to our subscribers there is a saving of 50 cents.

The last number contains an interesting article by Prof. Fewkes on the Sea Urchin, an article on Garden Vegetables by E. L. Sturtevant, and the usual summaries of Geography, Geology, Mineralogy, Botany, Zoölogy, Embryology, Physiology, Ethnology, Entomology, and two reprints in Microscopy.

Photo-Micrography.—On Tuesday evening, February 11, Dr. L. H. Laudy gave an illustrated lecture at the School of Mines, Columbia College, New York city, upon this subject. Those who attended saw some of the best pieces of work of this kind that have ever been executed. Dr. Laudy's skill as a photographer, combined with his successful adaptation of the microscope to photographic work, have given him results hitherto unattained in this field of applied science. It is useless to attempt to describe these results; they must be seen to be appreciated.—*Anthony's Bulletin*.

MICROSCOPICAL SOCIETIES.

ST. LOUIS CLUB OF MICROSCOPISTS.—E. J. NITZSCHMANN, *Sec'y*.

At the annual meeting, held at the College of Pharmacy, the Club elected the following officers: President, John C. Falk; Vice-President, C. C. Faris; Secretary, E. J. Nitzschmann; Treasurer, J. B. Whinery; Curator, C. M. Nicholson.

The Club has at present 29 members, and the Cabinet is constantly increasing. It was decided to have all microscopical journals bound and added to the library.

Prof. H. M. Whelpley presented a specimen of *Vallisneria*, showing cyclosis, and explained the manner for mounting the same. Mr. C. C. Faris exhibited an improved cover-glass holder, made of two grooved corks, attached to a lead base.

A paper on the subject of crystals found in plants was read by Mr. J. B. Whinery, who explained the different forms and shapes of crystal.

WASHINGTON, D. C.—L. M. MOOERS, *Sec'y*.

January 14, 1890.—The paper of the evening was read by Dr. W. H. Seaman, entitled "Carbon Dyes in Microscopy." The Society has recently made some valuable additions to its library and collections.

SAN FRANCISCO MICROSCOPICAL SOCIETY—C. P. BATES, *Rec. Sec'y*.

August 28, 1889.—The library was augmented by a number of valuable works on optics and microscopy, while the cabinet was enlarged

by a series of mounted slides, mounting material, and miscellaneous accessories, a gift from the Society's late associate, F. L. Howard.

Mr. Wickson presented a large collection of diatoms in situ, a donation from Professor George Davidson, of the United States Coast and Geodetic Survey. They come from the northern end of Lopez Island, in Washington Sound. The diatoms were accompanied by a sample of supposed diatomaceous earth found near Santa Rosa.

E. H. Griffith, of Fairport, N. Y., donated a series of mounted slides illustrating the gorgeous skeleton of the Diamond beetle or *Eupholus linnei*. The glittering scales covering the body of this member of the weevil family form one of the most brilliant objects that can be presented under the microscope.

C. C. Riedy exhibited a large collection of mounted diatoms from C. L. Petcolas. A slide prepared by that gentleman of the recently discovered Redondo Beach earth found some miles south of Santa Monica, is thought by him to be fully equal to the celebrated piece discovered at Santa Monica several years ago and published by the late Professor William Ashburner. Another remarkable slide in the collection exhibits what is known as the Eighth-street tunnel diatomaceous deposit of Richmond, Va., one of the finest deposits of strewn diatoms ever found. The slides of fossil marine diatoms from Syzran, Russia, and Kekko, Hungary, are also notable for the variety of their forms and the skilful manner in which they have been prepared before mounting.

F. W. Dunning, of Battle Creek, Mich., forwarded a box of diatomaceous earth from Lyons Creek, Calvert county, Md. He also sent a sample of diatomaceous earth broken from a piece found by a fisherman some time in June last, floating in the Pacific Ocean about two miles off the coast of Santa Monica. The latter material will be examined and compared with the original Santa Monica diatoms to determine whether it contains the same variety of forms.

Dr. Riehl exhibited a pure culture of *Staphylococcus pyogenes aureus*; also, a stained and mounted specimen of same.

—o—

SAN FRANCISCO, CAL.—C. P. BATES, *Secy.*

November 13, 1889.—The regular fortnightly meeting was held at 120 Sutter street. Two samples of diatomaceous earth from the Eighth-street tunnel deposit of Richmond, Va., were received from the Richmond Microscopical Society. An unusually interesting budget of microscopic miscellany was added to the society's files. Dr. Ferrer was present for the first time since his return from Europe, and exhibited a number of new accessories for the microscope, notably the following:

A new sliding nose-piece with centering attachment for use with high-power objectives. It consists of a body-piece, which screws to the nose of the microscope and remains in place, and the objective part, which screws to the objective and is fitted to the body by a sliding system. When in place, the objective is correctly centred by means of two keyed screws for forward and lateral motion, and once properly centred the objective remains in and is removed with the sliding piece, the body remaining on the microscope. Each objective is furnished

with a sliding piece to fit the one body, thus doing away with the double and triple nose-pieces, which soon become unsatisfactory from their tendency to wear and become loose at the collar-joints.

Another very unique device was an iris diaphragm, to be used in connection with the Abbé condenser, and which commends itself for the simplicity of its manipulation.

Two aplanatic lenses, one for use in the dissecting microscope, the other for low-power hand purposes, made by the well-known Steinheil, were also shown. Probably the most interesting of the Doctor's exhibit was the new illuminating apparatus called the Koch or Wolz lamp. It consists of a plain, round burner kerosene lamp, mounted on a stand that can be raised and lowered. It is covered by a chimney or japanned sheet iron with two tubulations on a level with the most luminous part of the flame, each tubulation holding a solid glass rod, one straight for the top light and the other curved for illuminating beneath the stage of the microscope. The rods are made of a new apochromatic glass, which has the peculiarity of transmitting a soft yet intense white light without apparently giving off any lateral rays, thus enabling the observer to work in a dark room and dispense with the aid of mirror or condenser.

A very fine series of photo-micrographs was added to the society's collection, one of the number a photograph of *Pleurosigma angulatum*, being taken at an amplification of 4,000 diameters with perfect definition. All the accessories noted, with the exception of the Steinheil lenses, were made by the celebrated optician, Carl Zeiss, of Jena, Germany, and were greatly admired by the members present for the fine workmanship.

A description of the improved Pasteur filter, called the Chamberlin filter, occupied a portion of the evening. It consists of a heavy metal casing enclosing several unglazed porcelain tubes that are fitted to the hollow cover of the outer casing; the water is admitted to the lower part of the large cylinder, and is forced through the porcelain tubes into the hollow cover, which is secured to the cylinder by heavy screws and a rubber packing.

The filtering capacity of a 3-tube filter, about a foot high, is a gallon of purified water in five minutes with the ordinary pressure of city mains.

—O—

Dec. 11, 1889.—Reception.—Four large tables were each presided over by one of the members, who followed the programme of exhibiting and elucidating as many objects as could be shown during twenty minutes. Then each exhibitor transferred his microscope and accessories to the adjoining table for a like space of time, and so on, till each, in turn, had occupied all the tables, thus giving visitors the benefit of the entire range of subjects presented without having to change their places.

A. H. Breckenfeld handled two binocular instruments, showing a series of objects with polarized light through one, and another set of mounts by transmitted and reflected light with the other. Among the polarizing subjects were brucine crystals, kinate of quinia, young oysters (rolling in fluid), toe of white mouse and *formica rufa* (the wood ant); by transmitted light, Rinnbock's geometrically arranged

diatoms, duodenum of rabbit, and head of crane fly; by reflected light, hairs of sea mouse, peristomes of mosses and feathers of humming bird.

C. C. Reidy exhibited diatoms, prepared in situ mounts, of Foraminifera graphically shown, with dark-ground illumination, produced in an original manner by means of water-immersion in connection with the Abbe condenser. He also displayed slides of insects illustrating structural anatomy.

E. J. Wickson showed the different forms and varieties of parasitic and insect eggs, some of them of intricate structure and presenting an ingenious adaptation of means to end. There were eggs round, disc-shaped, and of octagon form; others flattened and provided with a trap-door by which the newly hatched organism could make its debut into the world, without the necessity of cutting through a tough but transparent membrane that frequently presented all the colors of the rainbow.

The human skin and the structures adjacent and connected with it were shown by one of the exhibitors, while the slides prepared by him and beautifully stained proved of great value. One of the series illustrated the perspiration glands, together with the different layers of the skin through which they pass before emerging to the surface of the body; also, the subjacent areolar tissue and its connection with the glands.

A stained and mounted section of the human hair, shown in this series, gave many quite a different idea from what they had held. The hair follicle, the pigment cells, the different layers of membrane surrounding the hair itself and the hollow central tube that conveys the oil to the surface and keeps the hair smooth and glossy were all displayed.

NOTICES OF BOOKS.

Catalogue of Microscopes and Accessories. By James W. Queen & Co., Philadelphia. 8°, pp. 108.

This is the seventy-second edition of Catalogue B, and is issued on February 1, 1890. It contains all the latest improvements in the Acme Microscopes. Worthy of note are the full-page illustrations of Microscope stands. There are some reductions in prices, such as on microscopic cover-glasses.

Physical Culture. By Prof. D. L. Dowd. 12°, pp. 300. 80 illustrations.

This book is to accompany the Professor's Home Exerciser, and so the movements are mostly designed to aid those using the machine. There are, however, a number of exercises which do not require any apparatus whatever. Every movement is accompanied by an illustration, which shows the position of the body while in motion. There are also several full-page illustrations, showing the various muscles and bones of the human figure. In a chapter on dumb-bells the author says that a great deal of physical benefit can be derived from the use of dumb-bells, but that usually more harm is done than good. The exercises which he prescribes are especially valuable and free from objection.

Other chapters bear upon matters of great importance to health. This method of physical culture is especially fitted to the home and to schools where little apparatus can be used.

Scientific Catalogues. By W. P. Collins, London, England.

Catalogue No. 19 (June, 1889) contains a list of scientific books on Cryptogamia, Algæ, including the Desmidiæ and Diatomaceæ, Bacteria, Ferns, Fungi, Lichens, and Mosses.

Catalogue No. 21 (October, 1889) contains a list of Vertebrata, including Amphibia, Mammalia, Aves, Pisces, and Reptilia.

Catalogue No. 22 (December, 1889) on Microscopy (including Petrography), contains a large stock of pamphlets and excerpts from scientific journals classified and arranged for easy selection. A list of microscopical journals is also given.

Notes on the Fishes of Cayuga Lake Basin. By S. E. Meek. pp. 297-316 (reprint).

This is a descriptive and annotated list of such fishes as the writer found in 1885 and 1886. The nomenclature is that of Jordan and Gilbert. The specimens are at Cornell University.

Lessons in Botany. By Alphonso Wood, A. M., Ph. D. 12°, 220 pp. A. S. Barnes & Co., New York. (Price \$1.00.)

Children when twelve or thirteen years old may well begin the study of Botany. Dr. Wood's "Lessons" may be used for the purpose. It is beautifully illustrated with 532 figures, and has a carefully-prepared pronouncing index and glossary. We wish that the number of technical terms were very greatly reduced, but even the learning of these would furnish as much mental discipline as an equal amount of study devoted to Latin. Wood's lessons were originally written more than twenty years ago, but the editor has endeavored to incorporate the latest histological and microscopical research. We hope the publishers will take especial pains to introduce it into high-schools. In the Appendix is an analysis of the natural orders, by means of which the family of any plant in the United States may be determined, but there is no way of determining genus or species.

Elements of Astronomy. By Charles A. Young, Ph. D., LL. D. 12°. 472 pp. Ginn & Co., Boston. (Price \$1.55.)

This book is designed as a high school text-book. Much of the material is taken from the author's "General Astronomy," and many of the illustrations are used, but the entire matter has been carefully worked over, eliminating the more complexed features. Many of the statements are necessarily incomplete on account of the elementary character of the book, but they are all correct and accurate so far as they go. No mathematics higher than elementary algebra and geometry is introduced; in the foot-notes and in the appendix an occasional trigonometric formula is given.

The illustrations, over a hundred and fifty in number, are well executed and many of them are geometrical in their nature, while others are taken from photographs. Especially noteworthy among them are, the great telescope of the Lick Observatory, the great sun spot of September, 1870, and the structure of the photosphere, map of the moon from Neison, Gassendi, photographic telescope of the Paris Observatory, the Melbourne reflector, and the various maps of the constellations.

The appendix contains topics which, while they ought to be included in a high school text-book, are perhaps not essential to the course. There are also twelve pages of index.

A brief Uranography, covering the constellations visible in the United States, with maps on a scale sufficient for the easy identification of all the principal stars, is also presented. It contains a list of objects observable with a small telescope.

Young's General Astronomy has been introduced into about one hundred American colleges, and professors of astronomy have commended the book most highly. This evidence of success of the more complete work affords a weighty presumption in favor of the "Elements of Astronomy" by the same author.

Æschines against Ctesiphon. Edited by Rufus B. Richardson, Professor of Greek in Dartmouth College. 12°, 279 pp. Ginn & Co., Boston. (Price \$1.50.)

The basis of the present edition is that of the German one by Andreas Weidner. The text which is the unique feature of Weidner's work has been substantially reproduced. The introduction which covers 30 pages treats of the life of Æschines, including his career as an actor, soldier, public officer, his exile, relations with Demosthenes, and the characteristics of his oratory.

Although the orations of Æschines are interesting in themselves, they are doubly so when compared with those of Demosthenes, against whose views they are directly opposite. The *Oration against Ctesiphon* should be read as a companion piece to Demosthenes' *On the Crown*. In the present edition this necessary connection has been kept in view.

Æschines has decided merits of his own, which would make him a formidable competitor for the second place among the Attic orators, even if his struggles with the great orator had not placed him there. His orations have many features which are noteworthy; among those fairly characteristic of his style are the Apostrophe, his vivid presentation of a picture, exaggeration, a fondness for *figura etymologica*, the art of dramatic representation, inclination to digression, and the use of a pair of words to express a single notion.

This volume is one of the "College Series of Greek Authors," and like those which have already been issued, presents an attractive appearance in its typography, very full foot-notes, and neat cloth binding.

The Method of Least Squares. By G. C. Comstock, Professor of Astronomy in the University of Wisconsin. 12°, 68 pp. Ginn & Co. Boston. (Price, \$1.05.)

This elementary treatment of the method of least squares is an attempt to so present the subject to students of physics, astronomy, and engineering, that a working knowledge, based upon an appreciation of its principles, may be acquired with a moderate expenditure of time and labor.

The book presupposes only such mathematical attainments as are usually possessed by those who have completed the first two years of the curriculum of any of our better schools of science or engineering. The principle of least squares is derived from the observed distribution of residuals in certain typical series of observations. Especial care has been taken to apply all of the leading principles of the method to numer-

ical data selected from published observations, and to give the computations in full, so that they may serve the inexperienced computer as models.

Euripides, Iphigenia among the Taurians. Edited by Prof. Isaac Flagg. 12°, 197 pp. Ginn & Co., Boston. (Price \$1.50.)

This volume is one of the college series of Greek authors, and is not based upon any other commentary, but is an independent work, adapted to the needs of American colleges, and designed to facilitate the sympathetic study of this most charming and justly celebrated drama of Euripides. Since the play is well suited to be taken up as a first tragedy in a course of Greek reading, both the introduction and the Notes have been written with especial regard to the enlightenment of beginners in the Dramatic Literature. At the same time, the finer insight and higher cravings of the advanced reader are constantly remembered. The Introduction sets forth the *celebrity of the play*, with quotation in full of the most memorable classical passages that bear upon it; sketches the *legend*, in its literary and popular development; explains the rationale of the *plot*, with reference to the Aristotelian method of analysis; discusses the *artistic structure* of the tragedy, as to prologue, narratives, *dénouement*, etc., and gives a complete exposition of the *meters* and *technique*. The text, which occupies 132 pages, is printed in a clear and large type. The lines are numbered for reference. In the Notes, the grammatical material is presented with sufficient fullness, but mostly in a condensed form, with references to Goodwin and to Hadley & Allen; while the higher and more edifying matters of exegesis receive explicit treatment.

The Irregular Verbs of Attic Prose. By Addison Hogue, Professor of Greek in the University of Mississippi. 12°, 268 pp. Ginn & Co., Boston. (Price, \$1.60.)

In writing this book the author has aimed at helping students in the two directions in which they find the greatest difficulty in Greek, *i. e.*, the mastery of the forms and the acquisition of a vocabulary. Under the head of forms, the verb offers by far the greatest difficulty.

The book contains after the Regular Verbs—pure, mute, and liquid—the Irregular Verbs of Attic Prose in alphabetical order. Prominent meanings and special uses of frequent occurrence are given, often illustrated by translated examples. The most important compounds are added, and also many related words—forming a very practical sort of introduction to word-formation. The first declension alone is represented by about 400 substantives, and this indicates the range of vocabulary. The English Derivatives, of which there are over 450, prove an attractive feature to teachers and students alike. To the latter they will be an additional support in learning some five or six hundred Greek words, and will broaden their knowledge of their own tongue.

Greek Moods and Tenses. By W. W. Goodwin, LL. D. 8°, cloth. 464 pp. Ginn & Co., Boston. (Price, \$2.15.)

Since the publication of Goodwin's "Greek Moods and Tenses" in 1860, many most important additions have been made to our resources in the study of the Greek language. Comparative philology has thrown much light upon the early history of the language, and also made students of Greek more aware of their ignorance. The present enlarged

form is not intended for use as a grammatical text-book in the classroom, except, perhaps, the portion printed in the largest type. Nevertheless, the increased fulness and greater space given to the discussions will make the work more useful for private study and especially for reference.

An appendix, covering forty pages, bearing on the relation of the optative to the subjunctive and other moods, on the constructions with the infinitive, &c., forms an excellent feature. The index to the examples includes more than 4,800 extracts quoted or cited from the main body of the book. There are, also, given the greatest variety of examples possible from authors of different classes, illustrating many constructions which apparently need no such aid. A Greek index and also an English one, with reference to the sections, close the book.

Proceedings of the American Society of Microscopists.—Twelfth Annual Meeting held at Buffalo, N. Y. Volume xi, 8°, pp. 182. Buffalo, N. Y.

This volume contains the mature productions of several of the prominent microscopists of the country, and being issued this year with commendable promptness, should meet a cordial reception. The price, \$2.00, is not larger than society proceedings are usually sold at. It is true, nevertheless, that the same money would buy the two microscopical journals in which there is a prompt presentation of matter and a considerably larger quantity. The volume goes to members, however, free of charge. This Journal will take the liberty of reprinting such articles as have not already been presented, or as may seem most valuable to our readers.

Recent Writings of Interest to Microscopists.

I.—IN PROCEEDINGS OF THE AMERICAN SOCIETY OF MICROSCOPISTS, 1889.

BLACKHAM, G. E.—On the Amplifying Power of Objectives and Oculars in the Compound Microscope, pp. 22-31.

BURRILL, T. J.—A Microscope Stand. 53-63.

DRESCHER, W. A. E.—A New Form of Microscope, Filar Micrometer, Microtome, made by Bausch & Lomb Optical Company, Rochester, N. Y., pp. 131-134.

EWELL, M. D.—A Further Study of the Subdivision of the First Millimeter of "Centimeter A," pp. 64-66.

FELL, G. E.—A Simple and Efficient Deposit-Glass, pp. 139.

FELL, G. E.—Examination of Legal Documents with the Microscope—Qualifications of Examiner, pp. 102-108.

FELL, G. E.—Microscopical Examination of and Experiments with Glandular Secretions according to Method of Dr. Brown-Sequard, pp. 115-119.

FELL, G. E.—The Microscope in Diagnosis, pp. 67-69.

GAGE, S. H. and Mrs. S. P.—Staining and Permanent Preservation of Histological Elements Isolated by Means of Caustic Potash (KOH) or Nitric Acid (HNO₃), pp. 34-45.

HOWE, L.—Forms of Bacteria on the Normal Eye, pp. 120-125.

JACKSON, C. Q.—Bacteria in Ice, especially in Relation to Typhoid Fever, pp. 70-84.

KELLCOTT, D. S.—A New Rotiferon, pp. 32-33.

LEWIS, W. J.—Forensic Microscopy, or the Microscope in its Legal Relations, pp. 5-21.

LYON, H. N.—Notes on the Structure of the Moth *Attacus Cecropia*, pp. 135-138.

RAFTER, G. W.—On the Best Technique for High-Power Photo-Micrography, pp. 112-114.

ROGERS, W. A.—A Practical Method of Securing Copies of the Standard Centimeter, Designated "Scale A," pp. 109-111.

STEDMAN, J. M.—Researches on the Anatomy of *Amphistomum Fabaceum* Diesing, pp. 85-101.

TAYLOR, THOMAS.—Microscopic Investigations Relating to Tea and its Adulterations, pp. 46-52.

WIARD, M. S.—A Busy Man's Microscopic Laboratory, pp. 126-130.

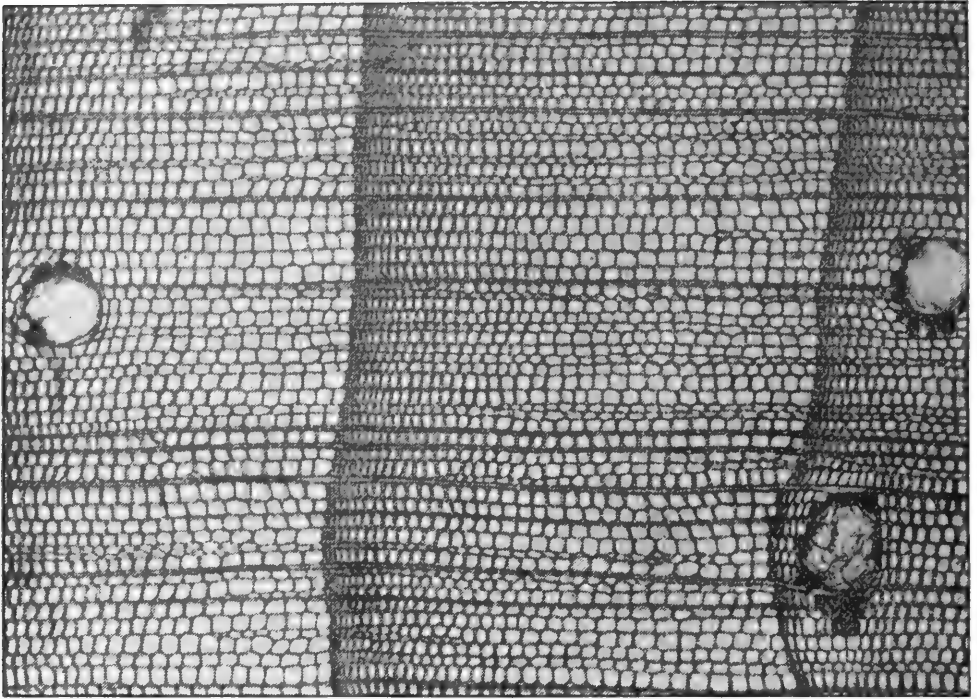


FIG. 1.—Sugar pine (*Pinus lambertiana*).

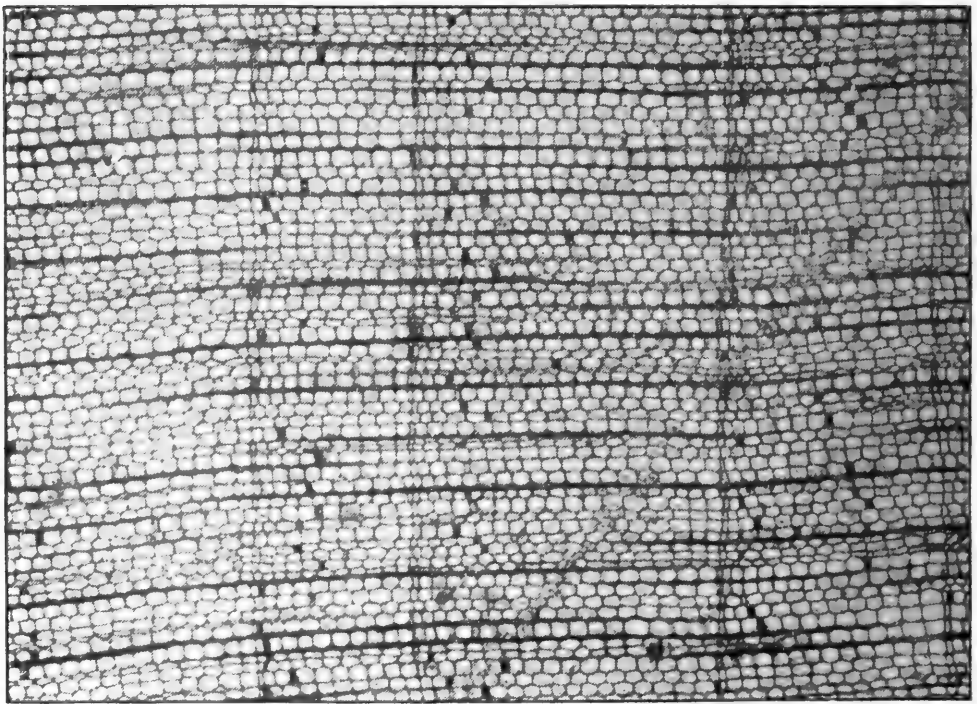


FIG. 2.—Red Cypress (*Taxodium distichum*).

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Microscopic Study of Woods.*

BY HENRY L. TOLMAN,

CHICAGO, ILL.

One of the most valuable aids in the determination of the value of woods is afforded by the use of the microscope, and it is possible by a

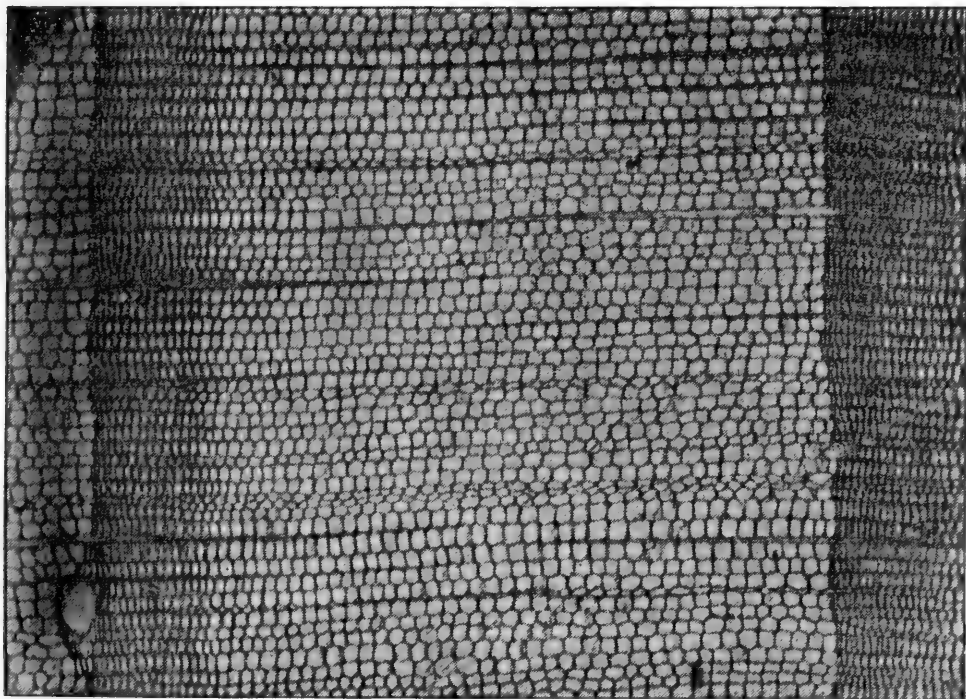


FIG. 3.—Yellow pine (*Pinus ponderosa*).

* From the *Northwestern Lumberman*, to whose courtesy we are indebted for the use of the illustrations. (In these figures the direction in which sap would flow is from right to left.)

microscopic examination to ascertain not only the coarseness or fineness of a given specimen, but its elasticity, durability, and adaptation for specific purposes. Trees, like all other vegetable substances, from the green slime that floats on a stagnant pond up to the giant redwood, are

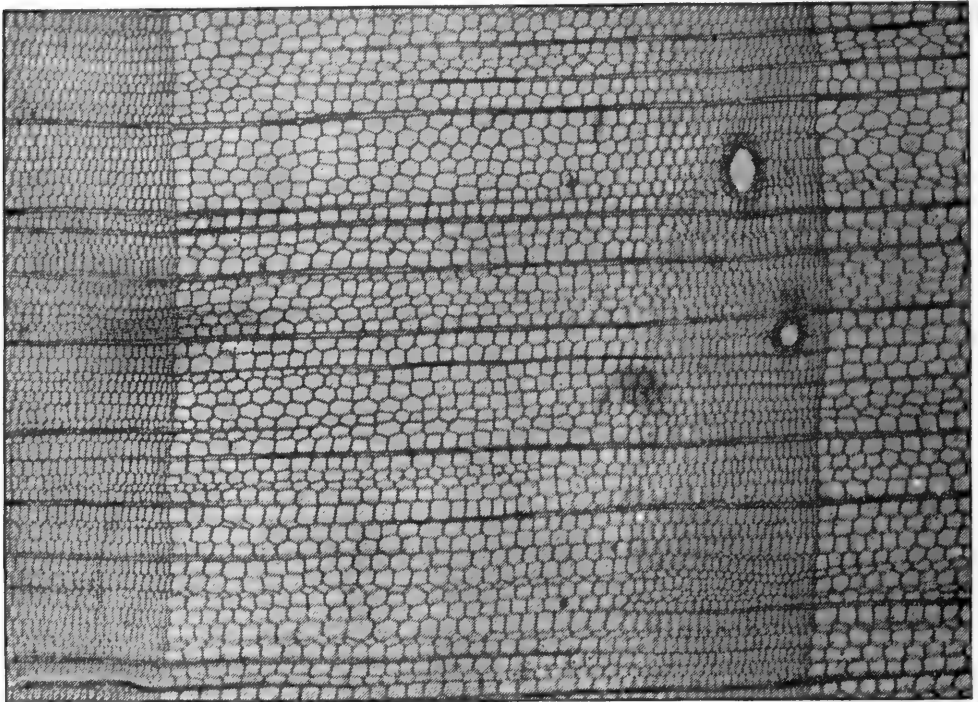


FIG. 4.—Red fir (*Abies douglasii*).

composed of cells—minute bodies of various shapes and sizes, generally consisting of a sac or membrane filled with fluid or air. Slice a ripe apple or melon, and the cells can easily be seen by the naked eye. The pith of the stem of an elder is composed of simple soft cells. The stem of a cornstalk shows similar cells, and also some of another kind arranged in bundles. The more simple the organization of the plant the more simple the cell structure. As we go higher up in the scale of life—and the rule applies equally to vegetable and animal—the structure grows more complex; it must be adapted to more varied uses, and hence must have more highly differentiated organs. The fluid in the young, freshly formed cells of plants is called protoplasm, and is the source of all growth. In it the different substances necessary for the growth of the plant are secreted, and when the protoplasm dies the plant dies. The most important element elaborated in tree growth, which forms all the sap wood, part of the heart, and a large portion of the bark is cellulose, a familiar example of which, nearly pure, is the common cotton of the well-known cotton plant. Pure cellulose is a white, soft, tasteless substance, insoluble in water or alcohol, and not easily dissolved by weak acids or alkalies. These characteristics are important to be remembered, as on them depend the qualities of different woods. The other chief important element in wood is lignine, which is chemically the same as cellulose, and may be defined as a hardened kind of cellulose. It is remarkable for the fact that it is still more inert than cellu-

lose, particularly to the action of water. Now, the character of a tree depends very largely on the proportion of cellulose and lignine, and this can be determined to a great degree by chemical reactions made on specimens of wood under the microscope. If a tree is nearly all cellulose the wood will be light-colored or white, soft, easy to split, and quick to decay, and very liable to swell or shrink with changes of weather. The tree will generally be short-lived, and will prefer moist, alluvial soil. The lignified tissue is the product of age and a certain degree of dryness, and is found in the highest degree in slow-growing trees, raised on high land or on a sandy loam. Other things being equal, the value of a hardwood tree is in direct proportion to the amount of lignified tissue it contains, though there must be some cellulose still remaining, or the wood will be brittle.

Though there are many varieties of cell structure, depending on the kind of tree and its mode of growth, there are only three or four which it is necessary to consider here.

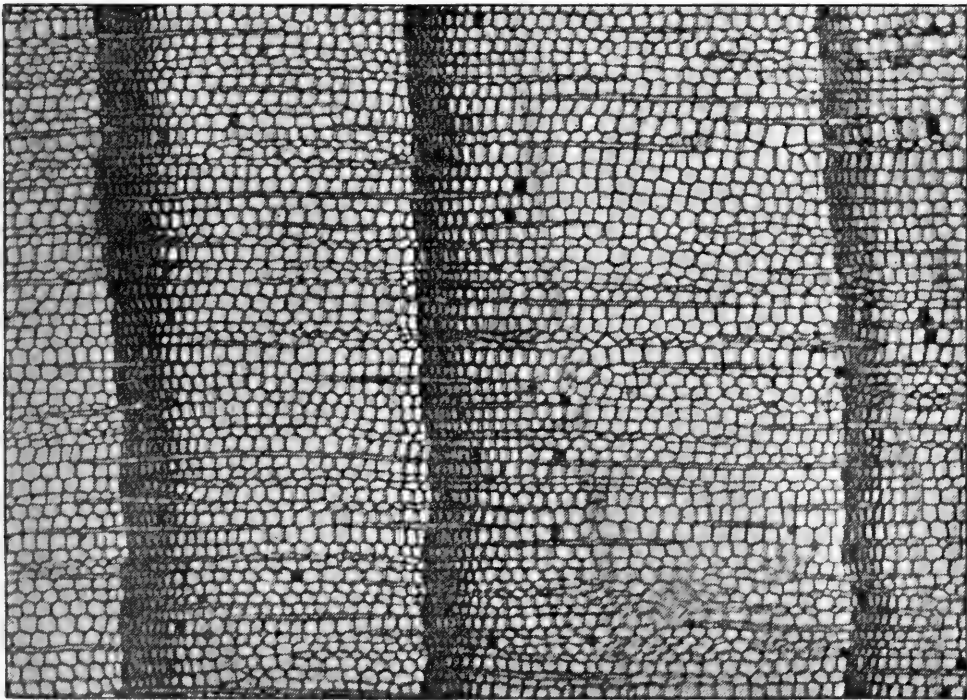


FIG. 5.—Redwood (*Sequoia sempervirens*).

The first formed are soft, thin-walled, nearly globular bodies, about 1-300th to 1-150th of an inch in diameter, growing rapidly by division and containing a large amount of fluid. These gradually become changed by mutual pressure into prismatic or elongated forms, and with the alteration in form comes a change in the part the cells perform in the development of the plant. It must be remembered that this cell structure is not due to an aggregate of individual independent organisms assembled together like a colony of bees, but it is one integral whole made up of innumerable parts, controlled by some influence which is termed the law of growth or law of development, so that a cherry pit never develops into an apple, nor a walnut into an oak. The second or

altered form of cells are those which make up the bulk of the heart wood of a tree, being elongated, thick-walled, tough cells of various forms, pointed at both ends and nearly solid. Some are divided into two or three parts with cavities in them; others, termed ducts, are hollow tubes, sometimes of considerable length, filled with air and with their walls curiously marked with lines, spirals, or dots. These lines or dots generally denote thin places in the walls, through which the sap can pass. In all the fully-formed tissue of wood the bulk of the cells will be found to be nearly empty, containing only air or a little water, but no protoplasm. Experience has shown that such cells do not grow after the cavities become empty, that no further progressive changes are made. Physiologically such cells are dead, but they are still of very great importance in the tree, because so long as they do not decay they form the frame-work which supports the branches and leaves in the living tree, and constitute the most valuable part of it when worked into lumber. If the cells decayed as soon as they ceased performing their functions, a tree would be only a hollow tube, with bark and two or three inches of sap wood. Precisely this occurs in old trees, where the pressure of succeeding cycles of growth has so crushed the earliest layers of wood as to deprive them of all nourishment and kill them completely, so that they begin decaying, leaving a hollow butt. Moreover, these cells are strongest and least liable to change under varying circumstances just after they have reached maturity, and hence the best lumber comes from fully-matured trees.

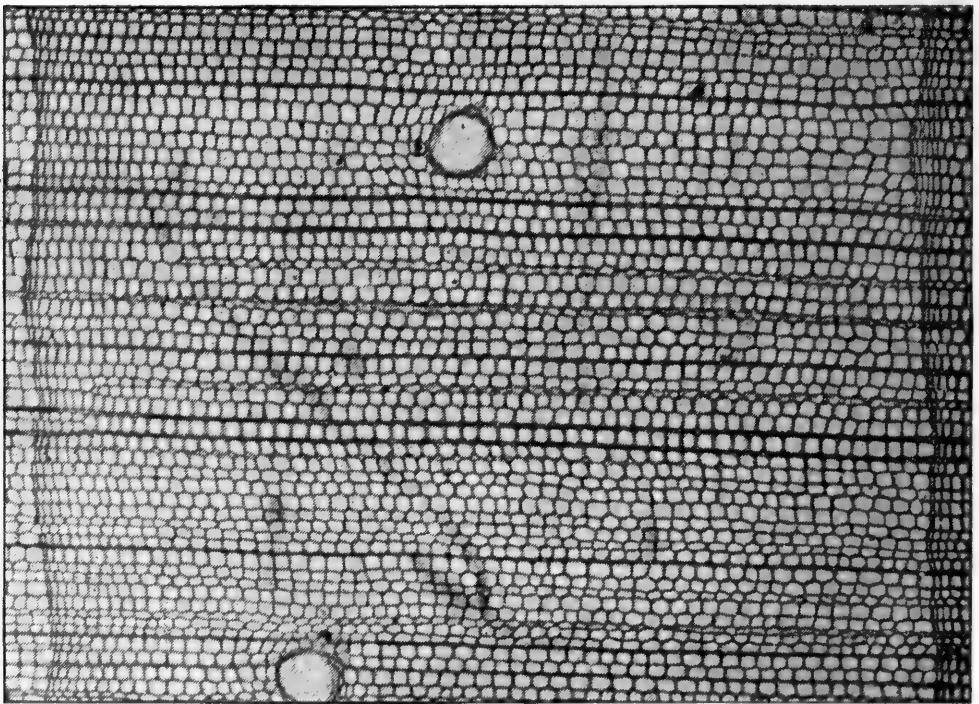


FIG. 6.—White pine (*Pinus strobus*).

Undoubtedly growing trees in their lusty youth furnish excellent lumber, but a critical, practical comparison between the two kinds shows that the latter, from the presence of an undue amount of water and cellulose elements, decays quicker, and shrinks and warps more in drying,

though possibly it might have greater flexibility. This condition of maturity varies greatly in different species of trees as in different shrubs and herbs. Some pass gradually on from youth to decay, while others after attaining their maximum endure for years with little or no change, either in appearance or in the quality of the wood. But as old age approaches in a tree certain signs appear, which an observant

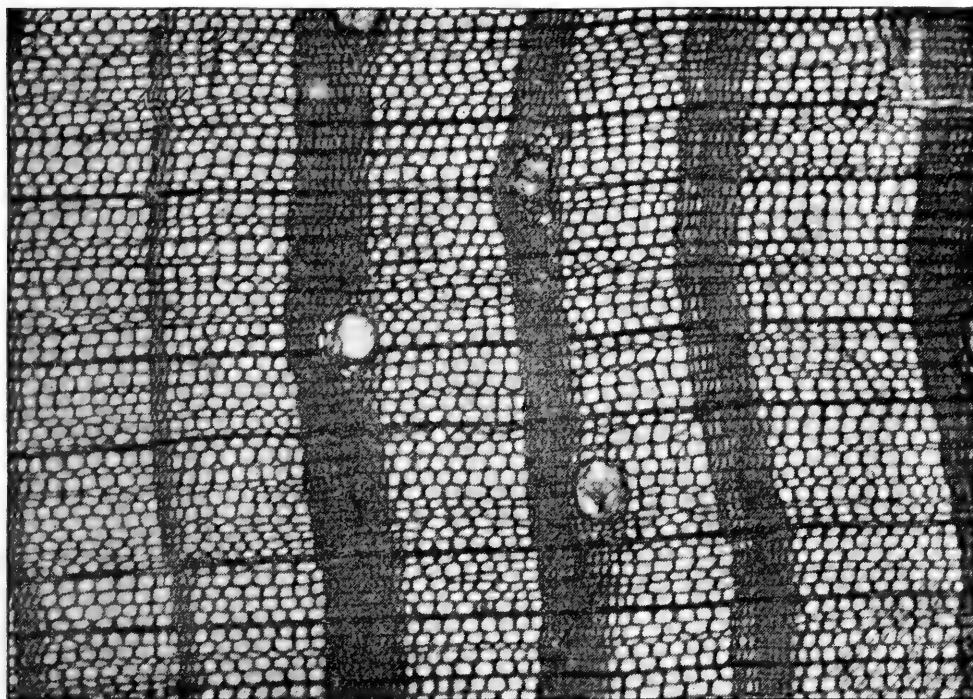


FIG. 7.—Georgia pine (*Pinus australis*).

lumberman will easily detect. The head of the tree becomes smaller, fewer leaves appear, occasionally a branch drops off, the bark becomes rougher and more covered with moss. With this outward change is a corresponding inner one. The lignification or hardening of the cells advances yearly, until the sap wood is reduced to a thin band only an inch or two thick in a tree three or four feet in diameter. After this there is no profit nor advantage in keeping a tree, and, on the contrary, in short-lived trees a positive loss.

The most superficial observer of lumber knows that there is generally a considerable difference between the wood of trees belonging to different species. Sometimes it is quite small, so that lumbermen have no constitutional objection to working off short leaf for long leaf yellow pine, hemlock for white pine, chittim wood, or yellow cottonwood for poplar and red birch for cherry, if it can be done without detection. The difficulty of distinguishing is greater among the conifers—the pines, spruces, firs, and hemlocks—than among the hardwoods, for the former are all formed on much the same pattern. Fig. 1 is a specimen of a transverse section of the California sugar pine (*Pinus lambertiana*)—that is, a section cut cross-ways of the wood as a cucumber is sliced. It, as well as all the other illustrations, is magnified 35 diameters, so that only two rings or circles of yearly growth are shown. The small cells are nearly square, representing true lignified wood cells, none of the growing cells

or parenchyma, as it is called, being seen. The parallel lines which run vertically up and down the picture at irregular intervals from an eighth to a half an inch apart, are the medullary rays which traverse the wood from core to bark, carrying sap horizontally in the growing tree. When they are numerous they are very prominent, forming what is known as the silver grain. When a log is quarter-sawed the medullary rays are specially marked. These wood cells, it will be noticed, are much thicker, and also closer together at the edge of each circle, and this denotes the wood formed in the fall when the sap is descending and cool weather has partly arrested active growth. Probably the lignification even goes on all winter. The arrangement and appearance of these layers of growth vary greatly with different species of trees. Many,

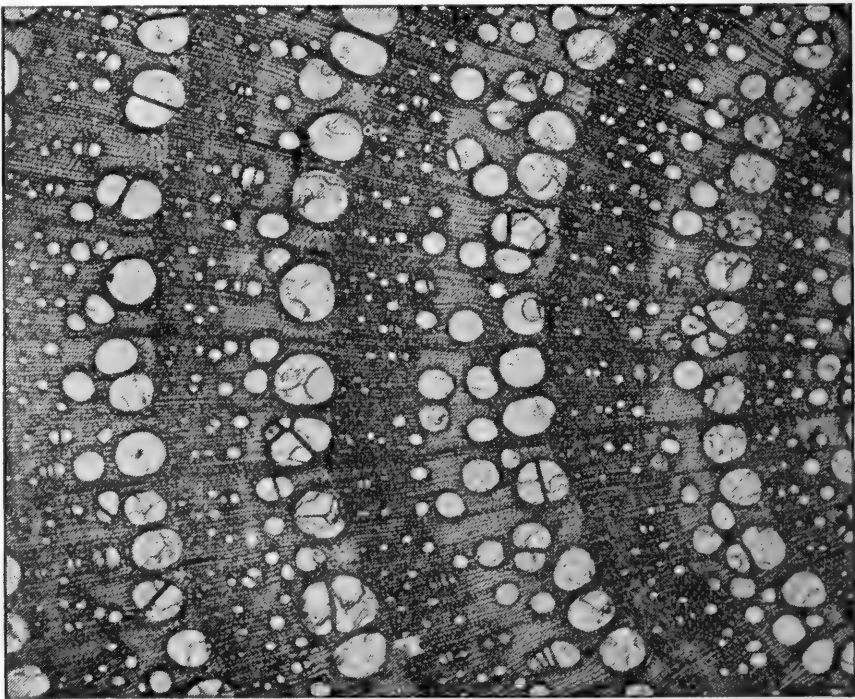


FIG. 8.—Poison oak (*Rhus toxicodendron*).

such as the magnolia, cypress, and poplar, form more than one layer a year. All form them of different thickness, from year to year, depending on the seasons and amount of annual rainfall, and microscopic examination shows that the seasons of slowest growth are those in which the lignification is most complete.

Fig. 2 shows a transverse section of red cypress from the rich, moist, alluvial soil of southern Louisiana, far south of the frost line. Although the annual cycles are uneven, yet the regular, evenly formed cell structure shows a soft, straight-grained wood, which keeps up its growth the whole year through. The numerous small dark spots indicate cells filled with the essential oil which gives the cypress its odor and is a cause of its durability.

Fig. 3 is a section of Oregon yellow pine (*Pinus ponderosa*), one of the most valuable of the pines of the Pacific coast, resembling closely in nearly all respects the sugar pine. The winter growth, however, is much more pronounced in the yellow pine, giving a prettier pattern,

but making it difficult to work. In Fig. 4 is represented the famous Douglas fir, the red or yellow fir, the most valuable and abundant tree of Washington and Oregon. The circles of winter growth, as it may be called for short, are unusually wide and dense at the edges, giving a prominent pattern to the wood, and the cells are thicker than in the other specimens shown above, indicating greater strength. The two large cells, or rather openings, in the edge of one of the circles are resin passages.

Fig. 5 represents the well-known redwood (*Sequoia sempervirens*) of California, with its fine, smooth grain. The circles of annual growth are narrow, and the bands of winter growth very small. The thin walls of the cells show how light the wood must be and how easy to work. The small black dots mark the resin cells.

In Fig. 6 is shown the king of all the softwoods, the white pine of the north (*Pinus strobus*). Here the annual circles are large, the cells of medium thickness; but instead of abruptly changing into a narrow, dense layer in the winter growth, there is a gradual thickening of the whole circle, so that the distinction between the last growth of one year and the first of the next succeeding is much less marked than in the specimens shown of Oregon yellow pine or Douglas fir.

In sharp contradistinction to the white pine is a specimen of Southern yellow pine, generally called Georgia pine (Fig. 7). Strength is evidently the leading characteristic, shown in the heavy individual cells,

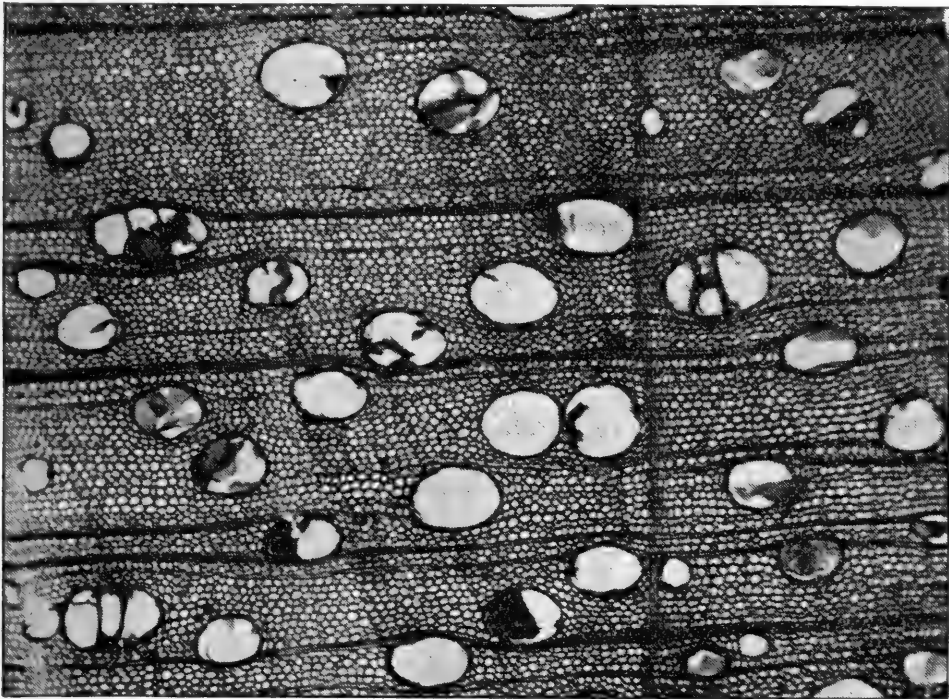


FIG. 9.—Black walnut (*Juglans nigra*).

as well as in the narrow circles of annual growth and the very wide bands of winter increase. The cells in the latter parts are especially remarkable for their thickness and density.

These forms, differing in minor particulars but evidently all of one type, represent the conifers, or, as they are popularly called, the ever-

greens. The other great type, the deciduous trees, is represented by Fig. 8, which is a small portion of a transverse section of the poison oak, a species of sumach. Here the spring growth is noticeable from the numerous large openings, which are sections of open ducts, while the later growth, composed mostly of small, thick-walled, dense cells, makes up the bulk of the annual rings. The difference in structure is shown at a glance, and it marks an equally great difference in quality. The large ducts are usually filled with air, but their thick walls give elasticity to the wood, while the very small, thick-walled cells, packed closely together, give strength. The most valuable woods—such as oak, ash, and hickory—generally have their ducts in rows, confined to the spring growth, while those in which the ducts are scattered indiscriminately throughout the wood—as walnut, linden, maple, cornel, gum, poplar, and mulberry—are generally much less dense, elastic, and durable. Marked differences occur, of course, in individual cases, owing to variations of soil, moisture, or climate, as trees are influenced to a large extent by their surroundings. The white oak in Michigan, with dense wood, narrow circles of growth, and almost invisible rows of ducts, when growing in the more genial climate and rich soil of western Tennessee shows annual circles half an inch wide, with very narrow bands of denser growth to mark the short, mild winter. Still further south, and the rank moisture of Louisiana urges the wood into a too luxuriant development, resulting in a coarse, brash, quickly-decaying timber growth. So, too, a dry, upland, gravelly soil will only allow a limited development, and a tree becomes dense and hard, but small, and the wood generally is brittle from too great a proportion of lignified tissue.

Lastly, as a specimen of a still different kind of wood, Fig. 9 is given, representing a transverse section of black walnut. The open, porous character of the wood is beautifully shown in the engraving, the ducts being very numerous and large, scattered indiscriminately throughout the whole wood, and the bands of winter growth being reduced to almost nothing.

These few specimens of tree growth only just begin to show the varieties which may be seen; but they are sufficient to indicate the value of the work and the accuracy with which, from such examinations, conclusions can be drawn as to the growth and character of any wood. Much more can be learned from sections cut parallel with the medullary rays, or radially, and from others cut at right angle to the medullary rays, called tangentially; but it was not possible to represent them all in the limits of one article. Enough to say, that microscopic examinations aid very greatly in showing why and how lumber warps; how to cut it to avoid this; why sap wood decays quickly; how to cut to get the prettiest pattern; why rift-sawed lumber wears the best; the causes of dry rot; the relative values of different kinds of timber, and the thousand and one other questions that are continually coming up.

Preservation of Urine.—As it is not always possible to examine a sample when fresh, Dr. Frank L. James, of St. Louis, Mo., suggests adding a crystal of Naphthalin as a preservative. This will accomplish the desired result without either affecting the character of the urine or modifying any subsequent tests.

Parasites of the White Ant.

By W. J. SIMMONS,

CALCUTTA, INDIA.

Professor Leidy's discovery of certain infusoria parasitic in the intestinal canal of the white ants of America, induced me to examine the white ants of Calcutta. The results have been sufficiently encouraging to warrant me in bringing them to notice. The alimentary canal in our white ants teems in its lower portion with parasites. In the renal excretory tubes you will sometimes find a moniliform organism which I take to be an Alga. There are in some cases myriads of non-ciliated organisms of an irregular elongated shape containing vacuole-like spaces; also a circular, nucleated, unicellular, non-ciliated organism. These two may be immature stages in the development of higher forms. Again, hosts of bacteria and spirilla will occasionally be present. I have also found Nematoid worms. The parasites which furnish the title to this note are of considerably larger size than those just mentioned, and are referable to the order *Holotricha*. They, however, seem to differ specifically from the infusorians. How exceedingly flexible the parasite must be in order to assume the different forms. From its being placed among the *Holotricha* you will know that it is ciliated all over its surface. It is a free and a rapid swimmer. Its length and breadth, owing to its constant changes of form, vary; the average measurements are: Length $\frac{1''}{125}$ Breadth $\frac{1''}{200}$.

The cilia at the anterior extremity are longer than elsewhere, and directed forwards, forming a ciliary tinge or collar around what I take to be the mouth parts of the organism. In some cases the cilia at the posterior extremity are slightly elongated, and form a more or less conical tuft, but they do not in respect to length approach the cilia of the collar. The body frequently shows parallel spiral markings which may indicate the position of the cilia, or a ridged surface. In some cases I have observed trichocysts, but I cannot say that they are constantly present in the cortical layer of these animalcules. There is a distinct and large nucleus, of circular form, the general location of which is central, though it may be nearer one or other end of the body. I have not yet detected any contractile vesicle, a feature this parasite shares in common with some other genera. The body is generally gorged with food, identical in appearance with the contents of the alimentary canal of the termites in which the parasites occur. They appear, therefore, to live directly on the semi-digested food contents of the intestine of their host. No one who has once examined the living mass which inhabits the white ant need be surprised at the voracious appetite of that destructive insect! I have spoken of the "mouth parts" of the organism, by which I mean a hyaline cap surmounting a narrow tube, probably pharyngeal, which is in most cases located at the anterior extremity. It does not occur in all the parasites I have examined; and, moreover, in some instances the cap is replaced by a minute hyaline sphere.

The tube and hyaline cap as seen are with a power of 600 diameters, and the cap and ciliary wreath as seen with a power of 800 diameters. It will be observed that the tube is contracted in the middle. When looked through, there seems to be an oral opening; but inasmuch as

the cap is perfectly transparent, it may well be that the view into the tube is only through the hyaline cap. Such of the parasites illustrated in Leidy's paper as have been reproduced in Kent's work have no such mouth parts as are observable in the animalcules which infested a large proportion of the white ants examined, and there are other differences. I nevertheless express myself provisionally as to these organs being mouth parts, because I have never seen food particles pass into the mouth, nor through the pharyngeal tube, nor have I detected them in its immediate neighborhood; indeed, the dimensions of some of the particles have been such as to preclude the possibility of their having passed down the tube, unless it be dilatable. From the identity of the food particles in the parasite with those in the intestinal organs of the termite, we must infer with Leidy that an oral aperture exists. I have paid some attention to the point, because it would be interesting to ascertain how the abundance of ingested food in the animalcule gains admission into its body. I have often observed the infusorian spinning rapidly on its longer axis without making, or even apparently attempting to make, progress forwards. Its revolving motion on these occasions has been too rapid to admit of my determining whether or not it was feeding. Again, in swimming through the semi-digested food of the termite, the parasite often assumes a helicoidal form at its anterior extremity, similar to the form observed by Professor Leidy in *Triconympha agilis*. Tentatively, I incline to the belief that on one or other, or it may be even both, of these occasions the animalcule is taking in food. In two cases I have observed animalcules bearing two tubes terminating in a single cap. Some idea of the variety of forms assumed by the parasites may be gained by comparing the different figures in the drawings before you.

Associated with the animalcule I have just described is another smaller and rarer infusorian. It entirely lacks the mouth parts to which I have called attention, though it also is not identifiable with any of the figures in Kent's "Infusoria." The cross-markings are best seen when the objective is focused for the central axis of the body, and the appearance is due to the parallel spirals on opposite sides of the body being in view together. This is obvious if a higher power giving, say, 800 diameters, is used. Whether or not this form differs specifically from the capped animalcule I am unable to say. Its shape is less variable. The cilia at its posterior extremity are slightly longer than those distributed over the rest of the body; and though the ciliation at the anterior end is directed forwards, it does not assume the appearance of the ciliary wreath or collar observable in the capped animalcule.

I endeavored to determine the portion of the intestinal tract which is the habitat of these parasites, and my observations so far lead me to consider that they are restricted to the ileum and colon of the white ant. I have not yet observed them either in the œsophagus, or in the proventriculus (gizzard), or in the chylic ventricle (true stomach).

Having found these infusorian parasites rather widely distributed among our local white ants, though they are by no means universal, I wrote to one of our Mofussil members, Mr. T. M. Francis, of Durbungah, who very kindly brought me down a box full of Behar termites. I examined dozens of these during the last vacation, and though I dare not venture to affirm that the Behar white ant is free from the

infusoria, I have no hesitation in saying there were none in the specimens examined by me immediately after I received them. I thereon put several Calcutta termites into the box with the Behar insects, which immediately sallied out of cover, and fell remorselessly on the poor, defenceless Bengalis! My object was, by associating the two breeds, to demoralize the high-spirited termites of Behar, and to infect them with the Bengal parasite; but, sad to relate, the entire brood succumbed, and my observations on the valiant Beharis were abruptly terminated.

On two or three occasions I have found bright green matter, evidently chlorophyll, in the intestinal canals of white ants from my garden. Is Firminger correct in maintaining that *termes* never attacks green and living plants? My friend Mr. Francis says he is convinced from his observations in the microscopic world that Firminger is wrong!

A rough and ready way of examining the termites for parasites is to cut off the abdomen of the insect, place it in a drop of distilled water, and tear it to pieces with mounted needles. More careful work is, of course, required if you wish to localize the parasites in the intestinal tract. Cochrane's brilliant crimson ink is an excellent stain for the organism. Osmic acid was used by me to kill them for the purpose of drawing them, and roseine to stain them. As to instruments, the work described in this note has been mainly done with Beck's Economic $\frac{1}{2}$ " and $\frac{1}{6}$ " objectives on a "Star" stand. The highest power used by me was Seibert's $\frac{1}{16}$ " water immersion, and this was only resorted to for the mouth parts of the parasite, as well as for the spirilla, and to ascertain the structure of the alga and of the other minute organisms. For work on the parasite itself, the $\frac{1}{2}$ " or $\frac{1}{3}$ " and the $\frac{1}{6}$ " are sufficient.

Note on the Wheat Rust.*

By H. L. BOLLEY,

LA FAYETTE, IND.

(1) What plant takes the place of the barberry in acting as hosts to the æcidium of *Puccinia graminis*? I, and I doubt not, many others would gladly answer directly. But that plant, with the necessary amount of fact to prove it, the wheat-growers' enemy, belongs to the category of the unknown. Several very common æcidial forms of unknown affinity, such as one to be found upon the evening primrose, have, because of their general distribution, similarity to *Æcidium graminis*, and proper appearance in point of time, become objects of suspicion to some.

However, mere opinion in this matter counts for naught. Proof fixed through actual culture tests is the only foundation for placing the guilt. Up to date, species of the barberry only are known bearers of that æcidium.

(2) In the *absence* of the barberry and *failing* a substitute, there are yet two possible sources through which there may be a spring infection, by direct infection through the *sporidia* (promycelial spores of the teleutospores) or through the dissemination of uredospores early abstracted from fungal hyphæ, which have passed the winter unharmed.

* Answers to queries induced by the article in the August number, 1889.

That the infection is a result of either of these possibilities has not been shown for the individual rust in question (*P. graminis*).

Many rusts (Micropuccineæ and Leptopucciniæ) reproduce themselves by means of one spore, form only the teleutospore. And it may be said that there seems to be no valid reason why the heterœcismal rusts, though they produce several spore forms, might not do the same. But the light of experiment is much against this theory. All attempts to produce an artificial infection of the disease in the wheat plant through the *sporidia* or the promycelium itself have failed.

In my study of the rusts of this region, I am convinced that the greater part of the "red" rust of wheat, usually attributed to *Puccinia graminis*, is not the uredo-fruited of that species but of a more common one, *P. rubigo-vera*. This is a much earlier developing species than *P. graminis*—easily attaining maturity, the teleutosporic stage, before the ripening of the wheat, while the teleutosporic form of *P. graminis* (the black rust of common talk) seldom appears before the harvesting of the regular wheat crop of our Central and Western States. Yet it usually does reach maturity in the oat fields and deserves more truly to be deemed the common oat rust than to be called as it is "the common wheat rust," though the application of such expressions is objectionable and not to be commended.

In this latitude I know *Puccinia rubigo-vera* to be able to live through the winter in the tissues of the young plants of winter wheat. At all times throughout the winter months of 1888 and 1889, I had no difficulty in collecting *uredo rubigo-vera* in quantity. I not only found the mycelium in good condition, but was able by marking diseased plants to observe the parasite begin the actual development of uredo spores in early March.

During the early part of winter pustules of *uredo-graminis* were also occasionally found, but not in sufficient quantity for extended observation.

I think that the mycelium of neither of these two species can be considered truly perennial, as, for example, in *Puccinia anemories*, yet in favorable circumstances both will be found capable of enduring the winter—*i. e.*, they become essentially winter animals in the same sense that wheat is a winter animal, *P. rubigo-vera* being the hardier of the two. And if in any part of this country conditions are favorable for the wintering of the mycelium of *P. graminis*, the winds, other atmospheric conditions being suitable, may account for the sudden outbreaks in any given locality.

(3) If the fungus be proved perennial, what becomes of the teleuto spores? The answer to this question can be placed upon the same basis as for the following: If we prove that potatoes can be reproduced from the potato ball (seed), what becomes of the tuber? That one spore form can apparently perpetuate the species does in no manner prevent another form from making an apparent surety more certain.

Points of value yet in doubt:

1. As in the case of *P. rubigo-vera* is the mycelium of *P. graminis*, a *winter animal* in some portions of our country?

2. (a) Is the so-called *P. rubigo-vera* of this country identical with the European species of the same name?

(b) If identical can the æcidium be developed upon other than the boraginaceous plants already determined?

BACTERIOLOGY.

By V. A. MOORE.

The Staining of Sections.*—Although it is sometimes possible to see under the microscope even single unstained bacteria lying in the tissues, it is absolutely necessary for more exact examination previously to stain them so that they are sharply defined from the surrounding tissues. For this purpose aniline colors are used, and of these there is not one which, when applied properly, cannot stain the bacteria. This, however, is not alone sufficient, for the chief desideratum is to stain them differently from their surroundings, and if aniline colors, after the first trials, are regarded as unsuitable, it is because one does not understand the proper way to differentiate the bacteria in sections which had been diffusely stained with them. The procedure of staining is, under some circumstances, very easy, and under other circumstances very difficult. It is a question not only of bringing into view all the micro-organisms, but also the ascertaining with exactness their relations, and this is only possible, when, by particular methods, we are able to make each individual part of the tissue so distinguishable from another that they in some way become also sharply defined from their surroundings.

Putting aside the staining methods, which were designed from the very first to stain the micro-organisms of a tissue only, leaving the other parts unstained, attention has been, till now, devoted almost exclusively to what are called good nuclear stains. These stains have, it is true, many advantages, where only a good view of the tissue is required; the disadvantage that the micro-organisms are covered by deeply stained nuclei cannot, however, be denied. For bacteriological purposes it is essential, above all things, to make the nuclei distinguishable from the other parts of the tissue, and I have tried to accomplish this end by methods which would stain the nuclei brightly, and the protoplasm of the cells somewhat more darkly. Such a method in no way interferes with the power of distinguishing the different tissues, but the covering of any stained micro-organism by dark nuclei is avoided. As a proof of bacteria in the vessels, this is, of course, of no great importance, but it is for the cases in which the organisms lie in the cells, or between them in cell-accumulations, as is the case, for example, in tuberculous nodules. In such cases we can easily show by comparative trials that preparations in which the nuclei are brightly stained, many more micro-organisms can be seen than those in which the nuclei are darkly stained. It is not the place to enter here into the chemical and physical processes which take place during the staining; it is sufficiently evident that it is not a mere mechanical deposit of staining stuffs. This is proved by the marked changes which often appear to occur to the stains whereby new colors are produced, which appear in many parts of the tissue.

I will mention only the violet color of the fat-cells (Mastzellen), when the tissues are stained with methylene blue. Indeed, our knowledge of physiological chemistry as well as of the so highly complicated aniline compounds, is not enough to enable us to set up a sufficiently

* Kuhne, *Praktische Anleitung zum mikroskopischen Nachweis der Bakterien im terischen Gewebe*. Translated by Dr. V. D. Harris, London, 1890, p. 8.

supported hypothesis which would be of practical use as one to work with, although I do not by any means wish to diminish the scientific value of having such a working hypothesis. I have thus contented myself with paying attention to the clearer and intelligible physical processes, and not without result. Starting from the supposition that the stain deposits itself in the interior of the tissues as such, and that it is fixed in it in different ways in different parts, according to the reaction thereof, I always give the preference to those methods which differentiate in a way most sparing of the tissue. On the supposition that many bacteria, *e. g.*, tubercle bacilli, take the stain with difficulty, one believed that one was able to remedy this defect by a long staining (twenty-four hours and longer), as well as by an increased temperature of the staining fluid, but we must recollect that by such procedures the tissue is so over-stained that the selective staining is very difficult, and the deep staining of the bacilli is quite illusory, even if we overlook the direct disadvantage of damage to the tissue. My opinion is that the difficult stainability of some bacteria in tissues generally is not proved; indeed the ease with which they take up the color in dry cover-glass preparations militates against such a view. In cases where failure results from staining for a short time, the fault lies in the process of differentiation being improperly applied. Any one may convince himself of the truth of this by staining sections containing different bacteria in weak solutions without applying means of differentiation, or by treating them as though they were dry cover-glass preparations. Such considerations make it appear most advantageous not to stain too deeply, and to seek some indifferent medium for extracting the color which will spare the tissue as much as possible. Such I have found among the aniline dyes themselves. At first I considered the acid staining matter only of much practical value for this purpose; later on I found among the basic ones some with similar properties.

I found a further weak point in the processes hitherto used, viz: The dehydration of already differentiated sections in alcohol, by which, under certain circumstances, the decolorizing properties of the fluid must have had a very bad effect. I tried to minimize this undesirable accessory effect of the alcohol by adding to it some of the stain in which the sections had been previously stained, and by these means a part at least of the staining matter removed by the alcohol was replaced.

Afterwards aniline oil was recommended by Weigert as a means of dehydration. I now use stained or unstained alcohol only for removal of the water superficially lying as it were upon the sections in order to make them spread out in aniline oil.

The alcoholic solutions of the acid stains showed themselves suitable only as a means of extraction of the color from the tissues in cases of bacteria, which retain the color very firmly, whilst they decolorized the others just as quickly as they did the tissue itself, and were therefore of no use without further processes. In such cases I found solutions of the acid and basic staining matters in clove oil suitable, which latter I finally replaced with much advantage by aniline oil, and latterly I have made use of this material only, either pure or containing staining matters for means of extraction, dehydration, and double staining.

Triple Staining of Sections Containing Tubercle Bacilli.*—

The sections are first stained in Delafield's hæmatoxylin solution, (1) after which they are allowed to remain in a considerable quantity of water for some hours to remove all traces of the alum. They are then dehydrated in alcohol and stained for ten minutes in carbol-fuchsin, (2) after rinsing in water they are placed in fluoresceine-alcohol to extract the fuchsin from the tissues, then in pure alcohol, ethereal oil, and xylol. From this they are placed in auramin aniline oil (3) for a few minutes until a yellowish tint has been obtained, when they are rinsed in pure aniline oil and passed successively through a bath of some ethereal oil, xylol, and finally mounted in balsam.

The nuclei appear violet, the cell protoplasm yellow, and the bacilli red. This method shows the cell boundaries very sharply defined, and gives generally excellent tissue pictures. The dark nuclear staining, however, does not admit of the greatest possible number of bacilli being brought into view, as some may be covered up by the dark nuclei. This method is, therefore, especially to be used for the staining of material in which the bacilli are in considerable numbers.

Kuhne's Modification of Gram's Method.†—The sections are stained in an alcoholic solution of methyl violet, diluted one-sixth with 1 per cent. watery solution of ammonium carbonate, or in Victoria blue for five minutes (the latter solution is not to be diluted). After staining, the sections are thoroughly rinsed in water and thus transferred to Gram's solution, in which they should remain for 2 or 3 minutes, when they are again rinsed in water and placed in fluoresceine-alcohol to extract the stain from the tissues. They are now rinsed in clear alcohol, cleared in oil of cloves or aniline oil, and finally passed through a bath of thin ethereal oil and xylol. Mount in Canada balsam.

The bacteria which take this stain appear sharply stained in the tissue, which is free from deposit and quite decolorized. The preparations are durable if the ethereal oil has been absolutely removed from the sections by xylol and then mounting in xylol-damar balsam, or in Canada balsam free from oil.

A very beautiful double stain may be obtained by first staining the sections fifteen minutes in carmine solution (Caccati). After staining rinse in water and then stain as described above.

In a second modification of Gram's method, the dehydrated, unstained specimens, or those previously stained with carmine are placed for ten minutes in concentrated watery violet solution to which HCl. (one drop in fifty) has been added. The sections are then well rinsed in water, treated as usual with Gram's solution, again rinsed in water, dipped for a few seconds into absolute alcohol in order to remove the adherent water, and finally put into pure aniline oil, which will provide for the extraction and differentiation, and at the same time will absorb the last trace of water. After the decolorization has been accomplished they are transferred into some ethereal oil, then to xylol, and finally mounted in balsam.

(1) *Delafield's Solution of Hæmatoxylin.*—To 200 c.c. of a concentrated solution of ammonia alum is added 12.5 c.c. of absolute alcohol in which 2 grams of hæmatoxylin has been dissolved. This so-

* Ibid., p. 28.

† Ibid., p. 33.

lution should be exposed to the air and light for three to four days, when it should be filtered and mixed with 50 c.c. of glycerine and 50.5 c.c. of methyl alcohol. The solution should be allowed to stand until it is of a dark color, when it is to be filtered and preserved in a well-stoppered bottle. Before using the solution it should be diluted, as the weak solutions give the best results. This logwood solution is to be preferred to all others of the same dye, as by its use deposits upon the sections do not occur.

(2) *Carbol-fuchsin*.—One gram of fuchsin is dissolved in 10 c.c. of absolute alcohol and 100 c.c. of a 5 per cent. solution of carbolic acid is added.

(3) *Aniline Oil Solution of Auramin*.—Auramin is very easily dissolved in aniline oil, so that a very few drops of a concentrated solution of it, if mixed in a suitable glass dish with 4 to 5 times its bulk of pure aniline oil, suffices for the purposes of differentiation and double staining.

(4) *Victoria Blue Solution*.—1 gram of Victoria blue is dissolved in 50 c.c. of 50 per cent. alcohol.

(5) *Solution of Iodine in Iodide of Potassium (Gram's Solution)*.—Four grams of iodide of potassium are dissolved in 100 c.c. of distilled water and 2 grams of iodine added, which is readily dissolved in the iodide of potassium solution. When used, enough of this solution is added to a watch-glass of water to give it the color of Madeira.

MEDICAL MICROSCOPY.

By F. BLANCHARD, M. D.,

PEACHAM, VT.

The Microscope in Diagnosis.—As widely used as the microscope is in pathology and in urinary analysis, it is rarely employed as an aid to diagnosis in sputa and the blood. This is an almost inexhaustible field for research. In the sputa the detection of elastic tissue by the microscope is certain proof of a breaking down of the lung, if such tissue be found in the expectoration continually. Again, the presence of tubercle bacilli is the first indication of bacillary phthisis, the elastic tissue and other signs and symptoms invariably following these.

By the rapid staining method, five minutes suffice to prepare for examination for tubercle bacilli. Dry lenses are made in this country of sufficient strength and definition to make the detection of tubercle bacilli easy. They have been seen with a power of 350 diameters, but with less than 500 the search is not satisfactory.

The examination of blood is not such a formidable undertaking as many think. In malaria it is of decisive importance, and although the magnifying power required is very high, still the staining procedure is simple, and the mere taking of a drop of blood from a patient's finger and spreading it on a cover-glass may be done in a few minutes.

These facts should be brought more into actual practice, and the microscope be used for a short time daily by every physician in the detection of these diseases.

A New Method of Detecting Oleo in Butter.

BY DR. THOMAS TAYLOR,

MICROSCOPIST OF THE UNITED STATES DEPARTMENT OF AGRICULTURE.

Dr. Thomas Taylor proposes the following new method of detecting oleo in butter as a result of over 1,000 experiments:

Dissolve in 20 c.c. of petroleum benzine, 140 grains of a mixture of oleo and butter. Heat slightly to secure a perfect solution of the oleo fat. Butter-caseine and animal tissues may be removed by passing the liquid, while warm, through fine muslin. Fill a test-tube with the solution and place in ice-water. In about 20 minutes the oleo fat will separate from the butter-fat and falls to the bottom of the tube, being insoluble in cold benzine, while the butter-fat will remain in solution in the benzine. Separate the oleo fat from the liquid butter-fat by filtration. The fat recovered may be solidified by mechanical pressure, placing it between several layers of bibulous paper to absorb the remaining benzine, after which the sheet of solid oleo may be removed from the paper with a palette-knife. The butter may be recovered by evaporating the benzine by means of a sand-bath.

A New Method for Detecting Cottonseed Oil in Lard.

BY DR. THOMAS TAYLOR,

MICROSCOPIST OF THE UNITED STATES DEPARTMENT OF AGRICULTURE.

Dissolve in 20 c.c. of petroleum benzine, 140 grains of a mixture of lard and cottonseed oil. Heat slightly to secure a perfect solution of the lard. Animal tissues should be carefully removed by passing the liquid while warm through fine muslin. Fill a test-tube with the solution and place in ice-water. In about 20 minutes the lard falls to the bottom of the tube by reason of its insolubility in cold benzine, while the cottonseed oil remains in solution in the benzine. Separate the lard from the cottonseed oil by filtration through fine bibulous paper, and subject the recovered fat to mechanical pressure between several folds of filtering paper, by which means the remaining benzine is absorbed. The solidified fat may be removed from the paper with a palette-knife. The cottonseed oil is separated from the benzine by means of a sand-bath, which evaporates the benzine.

Cleaning Diatoms from Sand.

BY NORMAN N. MASON,

NEW YORK, N. Y.

After removal of the organic matter with acid by the usual methods, add to the diatoms and sand in a large bottle, thirty, forty, or fifty times the quantity by measure of water, and gently shake until they are mixed. This water, with the diatoms and sand kept suspended by an occasional shake, is slowly poured in a small stream upon the upper end of a strip of clean glass 3 feet long by 3 inches wide and securely supported. The upper end of the glass should be from $\frac{1}{8}$ to $\frac{1}{4}$ inch higher than the lower end, and the glass should be level transversely. Beneath the lower end place any convenient receiver. The water and diatoms will

pass into the receiver. The sand, which will form little bars on the glass, must be removed occasionally, and it gradually creeps towards the lower end of the glass, and there would eventually pass into the receiver.

The loss of diatoms will be very small. Usually one pouring is sufficient for cleaning. The sand can be rewashed if necessary, or a little clear water run over the sand on the glass strip will carry forward almost the last diatom; but this will scarcely pay for the trouble. A short piece of glass will cause a failure, and too great an incline will be found almost as bad.—*Journ. N. Y. Micr. Society*, v. (1889), p. 116.

A New Method of Finishing Balsam Mounts.*

By F. N. PEASE,

ALTOONA, PA.

It is only a question of time when balsam mounts thoroughly hardened and unprotected from atmospheric influences will be ruined, on account of the cover-glass becoming detached, especially during rough handling. Discoloration of the mounting medium often occurs previous to the more serious result above mentioned, proceeding from the margin inward. On the other hand, preparations in which the balsam, storax, or other resinous media are used, are often injured by the running in of the cement used for finishing the slide, when sufficient care is not taken.

A method has been adopted, which effectually obviates these objections, and at the same time renders it possible to mount and finish a slide at once, without the delay due to allowing successive coats of cement to dry before others are applied. The mounts need not be thoroughly hardened before finishing, provided the nature of the preparation does not require it.

The method used is as follows: The object is mounted on the slide, applying the cover-glass in the ordinary manner, using either balsam, hardened balsam, balsam and benzole, storax or damar. The slide is then heated to drive off the solvent, or more volatile constituents, either gently in a water bath or at a higher heat, even boiling carefully over a spirit lamp when the nature of the object will permit.

When cold, the superfluous mounting medium when present, is carefully removed, then a narrow ring of paraffine wax is applied in the following manner: Hard white paraffine wax (such as is used for imbedding) is heated in a suitable capsule until it is melted and quite limpid. With the aid of a very small camel's-hair pencil, the melted paraffine is applied at the edge of the cover-glass, covering the exposed mounting medium and instantly solidifying. With round cover-glasses and a turn-table, very neat narrow rings of paraffine wax can be readily and rapidly applied. Whenever they are not satisfactorily symmetrical, a penknife may be used to bring them to the desired shape.

It is now necessary to apply a finishing cement. For this purpose Bell's cement has been found excellent, when modified as described below.

* From the *Microscopical Bulletin*, 1890.

The cement ring is finished at one application, enough being applied to produce a well rounded ring. In a few hours the slide is ready for the cabinet.

Bell's cement has been found at times to work unsatisfactorily, not flowing freely from the brush, and forming large bubbles in the ring, particularly in a warm room. The addition of a very little chloroform to the cement, and thorough mixing, produces a material that works smoothly and dries with a satisfactory finish.

The Filar Micrometer.—The following description is from the Proceedings of the American Society of Microscopists for 1889:

An internal frame is provided with a longitudinal and transverse cross-hair, which is adjustable within a limited range for position by a milled head at one end. The micrometer screw, which is cut according to desire, either to $\frac{1}{2}$ millimeter or $\frac{1}{50}$ inch, is adjustable by graduated disk and carries the cross-hair across the field. The graduation is in 100 parts on a silvered ring, and the reading is made from a stationary index. The graduated disk may be revolved on its axis. A comb is in the field, corresponding exactly with the pitch of the screw, thus enabling the determination of the number of revolutions. A Ramsden eye-piece is used, which is stationary in the optical axis and adjustable for focus. The apparatus is extremely delicate, and adjustable to any tube.

Through some error of the editor or committee the article above-quoted is entitled "*New accessories of the Bausch and Lomb Optical Company*," but Messrs. Bausch and Lomb do not claim anything new therein. They have made their micrometer to accord with suggestions of Dr. M. D. Ewell of what he considered correct principles. The real credit for originating the secondary slide, adjustment seems to belong to Mr. Walter H. Bullock, who claims that he has been making them for five or six years and who announced the same in this periodical in 1885, page 139, as well as in the Journal of the Royal Microscopical Society for February, 1886, page 132.

Death of J. L. De La Cour.—De La Cour, who died Dec. 26, 1889, was one of the organizers of the Camden Microscopical Society, and for many years took an active interest in microscopy. He was well known all over the country, and never tired of organizing societies when applied to, as he frequently was.

The Jena Optical Works.—Dr. E. Abbe, who until lately acted as a plenipotentiary of the firm of Carl Zeiss in Jena, entered the firm as a co-partner of Dr. Roderick Zeiss on the 29th of November. He has taken upon himself the sole management of the firm's business. Dr. Roderick Zeiss has retired from active participation in the business, though his interest in it is still considerable.

At the same time Dr. Otto Schott and Dr. Siegfried Czapski have been authorized to represent the firm.

Dr. Schott and Dr. Czapski are both well-known for their special acquirements in theoretical and practical optics, the former having hitherto had the direction of the Jena Optical Glass Works, whilst the latter has been Prof. Abbe's assistant during several years, and a frequent contributor to German scientific journals.

BOYS' DEPARTMENT.

Little Grains of Sand.

BY E. C. HOYT,

DETROIT, MICH.

Several years ago, when I conceived the idea of making a collection of all the sands I could get, I undertook, from Webster's Unabridged and a large line of microscopic books, particularly those upon the subject of mineralogy, to learn what sand really was. Although so common, I have never been able to find in any book anything satisfactory. Definitions are quite uniform, "mineral fragments." But sands are quite varied, even in the same localities.

Along the shores of Lake Pepin there are strata of different colored sands which the Indians arrange in layers in small bottles and sell to passengers on the Mississippi river steamboats.

It requires the microscope, however, to see this combination to best advantage, and with the microscope and polarizer, there is a great opportunity for study at comparatively trifling expense.

Including *mineral fragments*, by which are meant small pieces of known minerals crushed into sand, I find in my cabinets over 700 varieties, but as the subject of mineralogy is a wide one, including, as Prof. Dana claims, water and ice, this article will be confined strictly to sand, *i. e.*, sand as found in nature, and we can refer only to a few of the most striking, and touch upon some of the forms found in sand.

Viewed microscopically, there are at least 4 classes: 1.—Opaque. 2.—Polar. 3.—Both opaque and polar. 4.—Those which show to best advantage with paraboloid. Some of the latter class are also interesting as polar objects, although the effect is so different that they would not be recognized as the same. I have never found a sand but what was of more or less interest.

Among opaque sands are gold, silver, copper, garnet, iron, oolitic, agate, diamond, pictured rocks, foraminifera, magnetic, polycistina, diatom, boiling spring, and scores of other sands.

The gold sand has little pellets of pure gold, associated with quartz. The silver has fragments of wire silver; both beautiful. The garnet is a combination of angular grains of all colors. Oolitic grains resemble beans, and are usually white, though one slide from Australia has brown shades. The "pictured rocks" is from Lake Pepin, and the larger grains are perfectly round and of a reddish shade, the smaller of a variety, such as white, yellow, light green, &c., angular in shape. Diamond sand is largely "Lake George" diamonds—quartz crystals—very small, resembling diamonds. Others are suggested by their names.

"Blotting sand," such as was once used, is a black iron sand. One variety from Isle of Sol, Africa, resembles gunpowder, but feels like asphalt.

In many ocean sands are found things of interest, such as diatoms, polycistina, foraminifera, fragments of marine animals, shells, etc.

Polar sands are more interesting and of greater variety. Almost all ocean sands are polar. The finest I have found was off Cape Henlopen.

In Greenland sand each grain is a picture in itself, containing either a crystal, a fluid, or an air cavity, or sometimes all.

Desert sands, even, vary. Arabian desert is almost pure quartz. Egyptian desert is largely quartz, although I have one slide mounted as "rolling sand," by M. S. Wiard, which is a most beautiful medley; still it is *largely* quartz. The Sahara desert is alone quite a beautiful mixture.

Pine Barren sands also vary. The pine barrens of Michigan, where our State Agricultural College has had a station for years, with no encouraging reports, is a round grain, a small gravel stone. The poor lands of Wisconsin, formerly pine lands, now so worthless that it would require the ingenuity of "Bill Nye" to illustrate it, are also of the same form of grains, while the pine barrens of Lockwood, N. J., appear rich enough to raise 40 bushels of wheat to the acre.

The Charleston earthquake rather astonished people in regard to sand. There were over 50 varieties found, of which, through the kindness of Miss M. A. Booth, I have 25. They are largely micaceous sands, and my theory is that the shock was so severe as to *separate* the several varieties of sands according to size of grains and weights. There are many in which the only perceptible differences are in color.

Marble Dust is another interesting study. Marble, as all mineralogists know, is simply an aggregation of sand roundish in form. Mr. E. H. Griffith gave me 2 specimens for mounting. One I found to be marble dust. The other is probably pulverized calcite, for certainly under the microscope they do not resemble each other, and yet both are sold as marble dust.

Bermuda sand, where "sweet onion" grows, is almost entirely composed of shells of foraminifera. Vesuvius lava is practically a sand, and of exceeding interest. Other lavas are more or less so.

Oil-well sands, from 100 to 1,100 feet, are a mixture of great variety, while gas-wells vary largely, finally reaching into and through pure rock.

The Maine sand dunes follow one system throughout the State and are of great interest.

Florida produces a great variety, from the large oolitic sand to the finest pure white sand. I undertook at one time to make a "sand picture" on a slate, and this white Florida sand was so fine that enough would not adhere to show the color.

From Washington a large ungainly sand is received, seemingly covered with a dirty yellowish cement (concrete).

From Lookout Mountain, Tenn., comes a very rich sand; but Kansas sand is the richest of all in feldspar.

Lincoln Park, Chicago, has a most beautiful sand. Milwaukee sand is the same, only the slide is spoiled by about 10% of opaque grains.

Canoga, New York, has the only nitrogen spring mentioned in Dana. The sand is a lovely variety.

Death Valley, Arizona, is a place where very few escape alive. Its sand has the appearance of having been *cooked* or *baked*.

Isthmus of Suez has a mixture of quartz and opaque sands.

Sands from old monastery wells in Burmah, India, show an interesting variety.

Chataquay Lake, N. Y., has a beautiful sand, and *one grain* is a perfect picture of a crown.

Diamond sand shows most perfect concentric rings, sharp layers of

red, purple, yellow, blue, &c. I hope to create an interest in sands, for the reasons that they cost practically *nothing*, and are among the most beautiful things to be seen. There is no piece of jewelry in Tiffany's diamond store in New York, as beautiful as an ordinary slide of grains of sand, and their diamond expert who receives a salary of \$300 per week is as enthusiastic upon this point as any other man, and says so.

With paraboloid, garnet sand is one of the most beautiful pictures the mind can contemplate.

With binocular and paraboloid we can almost look through a grain of sand, and the structure is also an interesting object and study.

NOTES.

The collection of microscopical slides of the late Prof. de Bary, numbering nearly 4,500, has been purchased by the British Museum.

Genuine honey can be readily distinguished from manufactured honey, by the microscope, as the former has few or no sugar crystals.

"Phosphorescence."—A French naturalist, M. Giard, has just made known the results of some experiments he has been making with *Talitrus* and other crustaceæ. On microscopically examining a brightly phosphorescent specimen he found walking slowly on the beach instead of leaping, as its habit usually is, he traced the phosphorescent light to the presence of bacteria in its muscles, which were greatly altered. On inoculating other and healthy individuals of this and other species the same disease was produced amongst them, and M. Giard says that his laboratory was quite lit up at night with these diseased but luminous crustaceans. The inoculation was continued to the sixth generation apparently without any attenuation of the microbic action. The disease seems to follow a regular course, and the crustaceans died in three or four days. The phosphorescence, however, always lingered a few hours after death. Crabs were inoculated in the same way.—*Science-Gossip*, Nov., 1889, page 256.

Prof. C. H. Rowley.—This well-known microscopist is in charge of the department of microscopy of the National University, Chicago. The theory of microscopical vision is taught, and every student aided in obtaining a scientific knowledge of the instruments used.

Nearly all branches of microscopy are included in the course, the technique of slide mounting, manipulation of tests, how to work objectives in order to obtain their greatest performance—in short, everything needed for the student to pursue the work ever after with profit and delight. Work in this department can be done in histology, pathology, botany, biology, mineralogy, cryptogamia, etc. It includes also the preparation of slides illustrating work in these studies, including insects, spiders, worms, entozoa, polyzoa, hydrozoa, rotatoria, infusoria, diatoms, foraminifera, bacteria, etc.

American Society of Microscopists.—The next meeting of this society will be held at Louisville, Ky., from August 12 to 15, 1890.

MICROSCOPICAL SOCIETIES.

WASHINGTON, D. C.—L. M. Mooers, *Sec'y*.

101st Meeting, March 11.—Dr. J. M. Lamb read a paper On the Examination of Sputum, treating the subject first historically, then as to its importance in the diagnosing of phthisis and kindred diseases, and lastly the technique and details of preparation and examination. The paper was received with much interest, and brought out remarks by Dr. Reyburn, Dr. Acker, Mr. V. A. Moore, and others. The Society will hold its annual soirée on the evening of April 22d, invitations and programmes for which are being prepared.

BROOKLYN MEDICAL MICROSCOPICAL SOCIETY.

29th Meeting, January 8, 1890.—Dr. Heitzmann presided. Drs. Eugene Hodenpyl and Ira T. Van Giesen were elected to active membership. The paper of the evening, on "Villous Tumors of the Bladder," was read by Dr. Jones. It was illustrated by plates and specimens, and discussed by Drs. Heitzmann, Wilson, and Jones. A paper by Dr. L. Heitzmann on "Bacteriological Examination as an aid to Clinical Diagnosis," was announced for the next meeting.

ST. LOUIS CLUB OF MICROSCOPISTS.

February 4, 1890—Mr. C. C. Faris exhibited an improved cover-glass holder, made of two grooved corks attached to a lead base. A paper was read by Mr. J. B. Whinery on the subject of crystals in plants, giving a description of their shapes and sizes. Mr. C. C. Faris donated to the cabinet slides: petiole of begonia, kamala, bichromate of potassium, and chromate of potassium.

SAN FRANCISCO, CAL.—C. P. Bates, *Sec'y*.

February 26, 1890.—The regular fortnightly meeting was held at 120 Sutter street, President Payzant occupying the chair. Communications were received from numerous sources and quite an addition made to the library. The cabinet was increased by a number of well-prepared pathological and mineral slides donated by Dr. W. N. Sherman, of Merced, Cal.

Dr. Henry Ferrer gave a lecture, his subject being the best and simplest method of manipulating stage and eye-piece micrometers. He demonstrated his remarks by a practical exhibition of the most reliable forms of micrometers, and explained the way of using them. Recent specimens and also mounted and stained sections of *Cysticercus Cellulosæ*, or bladder worm, were exhibited, and its peculiar characteristics demonstrated.

William Payzant, the president, read his annual address. C. C. Riedy, the treasurer, submitted his report for the fiscal year, showing that the financial matters of the society had been ably handled. The selection of officers for the ensuing year resulted in the election of the following persons: E. J. Wickson, president; C. P. Bates, vice-president; William E. Loy, recording secretary; A. H. Breckenfeld, corresponding secretary; C. C. Riedy, treasurer.

NOTICES OF BOOKS.

Les Trois Mousquetaires. By Alexandre Dumas. Edited by Prof. F. C. Sumichrast. 12°, pp. 289. Ginn & Co., Boston. (Price 80 cents.)

The present edition of this justly celebrated novel of Dumas is an attempt to offer a condensation of the story, giving the brilliant descriptions and characteristic dialogue and the captivating rush of adventures untouched. The objectionable passages are excised, and the volume brought within such limits of length that it may be conveniently used as a text-book. The notes are divided into two parts. The first consists of explanations of the difficult passages and allusions, and the second biographical and geographical notices of the principal historical personages and places mentioned in the narrative.

Digestive Ferments. Compiled by the Publishers. 16°, pp. 148. Parke, Davis & Co., Detroit.

This little hand-book is of especial interest to physicians and pharmacists, to whom copies will be sent upon application to the publishers. The chapters relate to (1) their necessity; (2) preparations of pepsin; (3) pancreatic; (4) their use; (5) literature of the subject; (6) pepsin and its congeners, etc.

SUBSCRIBERS' NOTICES.

[These notices will be given six insertions in this column at 25 cents per line or fraction thereof.
FOR EXCHANGE.—Slides of selected diatoms. D. B. WARD, Poughkeepsie, N. Y.

WANTED.—Unmounted microscopical material, also micrographic dictionary. Will exchange or buy. CHARLES VON EIFF, 124 Clinton Place, New York City.

WANTED.—A clean copy of Rev. William Smith's British Diatoms, and Schmidt's Atlas of the Diatomaceæ. JAMES B. SHEARER, Bay City, Mich.

OFFERED.—Diatomaceous Earth from Utah (Desert) for Histological Mounts. PROF. ORSON HOWARD, Salt Lake City, Utah.

CORRESPONDENCE invited with a view to the exchange of either mounted or unmounted Oribatida (British) for American species. E. BOSTOCK, Stone, Staffordshire.

WANTED.—Any works on Microscopy not already in my Library. H. M. WHELPLEY, F. R. M. S., St. Louis, Mo.

WANTED.—(In exchange for slides.) "Microscopical Bulletin," Vol. I. No. 5, August, 1884. M. S. WIARD, New Britain, Conn.

Labels in exchange for slides. EUGENE PINCKNEY, Dixon, Ill.

First-class Histological Slides for other good mounts; Histological and Pathological material cut on shares. S. G. SHANKS, M. D., 547 Clinton Ave., Albany, N. Y.

OFFERED.—Griffith & Henfy Micrographic Dictionary to be sold; also Hoggs Microscope. J. P. WINTINGHAM, 36 Pine St., N. Y.

WANTED.—A clean copy of Wolle's Fresh-Water Algae of the United States (2 vols.); also good second-hand Grunow Camera-Lucida, and a self-centering Turn-table. JOS. P. THOMPSON, P. O. Box 1383, Portland, Me.

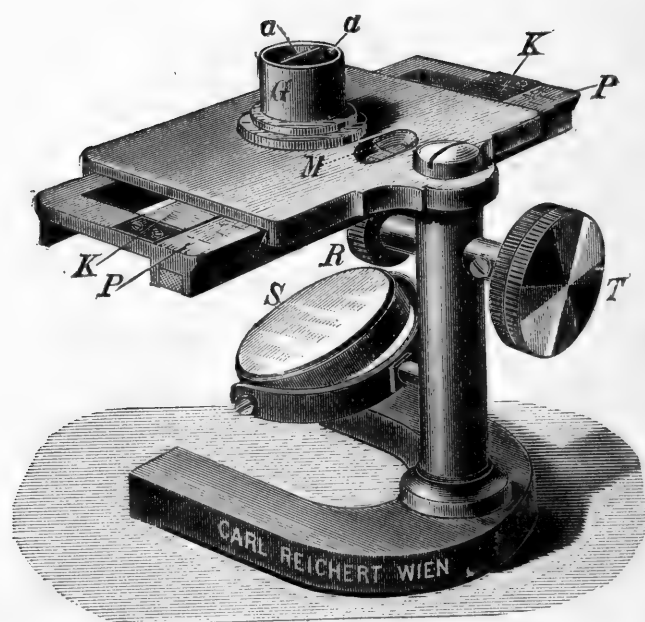
FOR SALE CHEAP.—New Gundlach $\frac{1}{18}$ homogeneous-immersion objective, for $\frac{1}{2}$ glycerine or water objective.

FOR SALE.—A Bausch & Lomb Stand, A. & C. eyepieces, 1 in. and $\frac{1}{2}$ in. objectives. BOX 1, Evanston, Ill.

FOR EXCHANGE.—Cabinets of lower silurian fossils for microscopical apparatus or objects. Correspondence invited. E. L. SHERWOOD, Houston, Miss.

OFFERED.—\$400 in prizes. For details see article in January number of this journal for 1890. C. A. STEPHENS, Norway Lake, Me.





REICHERT'S HÆMOMETER.

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European subscriptions may be sent directly to the above address accompanied by International Postal Order for \$1.15 per annum, or they may be sent to Messrs. Trübner & Co., 57 Ludgate Hill, London, or to Mr. W. P. Collins, 157 Great Portland street, London, accompanied by the yearly price of five shillings.

Concerning the Rules and the Application of Reichert's Hæmometer.*

BY FREDERICK GAERTNER, M. D.,

PITTSBURG, PA

This apparatus is designed to ascertain the amount of hæmoglobin in either a diseased or a normal condition of the blood. It was devised by Prof. E. von Fleischl, and patented by Carl Reichert, of Vienna. (See frontispiece.) This little instrument, the Hæmometer, is the result of a need felt by physicians and scientists of having an instrument which will give a quantitative judgment (analysis) of the value and function of the hæmoglobin in the circulating blood. It was further necessitated by the inapplicability of the methods thus far prescribed for this purpose to the cases encountered by physicians; and, finally, it arose from the hope of advancing our physiological and clinical knowledge by rating the per cent. of hæmoglobin in diseased human blood.

The Hæmometer cannot be used either by daylight or by the electric light, and only by the light of oil lamps, candles, and gas.

Every examination of blood by means of the Hæmometer must consist of these three operations: 1. To obtain and measure the blood. 2. To dissolve it in water, and to fill the instrument with this solution. 3. To arrange the instrument and read the results.

This apparatus consists of a small and simply constructed horseshoe base, composed of a foot, column, mirror, and table. Beneath the table is a frame which bears the glass wedge K, the latter being propelled by the milled-head screw R. Upon the table is a cylindrical vessel G, the one-half of which (α) is filled with blood which has been diluted with water, so as to be examined. The other half (α') is filled with pure spring water, after a tube, whose capacity has been exactly gauged, has itself been filled with blood by capillary action. It is brought into the

* Read before the Iron City Microscopical Society.

half of the vessel at a , where the blood contained in the tube dissolves in the water until it becomes a perfectly transparent liquid. By the optical conditions of the apparatus it becomes possible under an illumination of oil lamps, candles, or gas light to find a position of the glass wedge K at which the color and brightness of every such blood solution is exactly the same. This point is sought by moving the wedge backwards and forwards by means of the micrometric screw T, and by giving the reflector a definite position, S.

Upon the frame which surrounds the wedge, a scale P is engraved, a part of which is visible through the aperture at M. This gives exact results in percentage of the amount of hæmoglobin in a certain blood solution. There is also a stationary index line on the side of the aperture M, which points also to the discovered amount on the scale.

This Hæmometer presents the following advantages:

1. Easy and convenient management of the apparatus.
2. Rapid and direct results in percentage regarding the degree of normal hæmoglobin.
3. The small quantity of blood, only a drop, required for the examination.

It is best to take the blood from the tip of the left middle finger.

After the skin has been thoroughly washed and carefully dried, and without any preceding compression, or binding of the finger, as is usually done, it should be wounded by a slight prick with a sharp needle. Then by a slight pressure above the little wound a drop of blood is secured. This drop of blood is taken up with one of the open ends of an automatic blood pipette, a small capillary tube about 8 mm. in length, bound about in the centre by a tiny wire, and of definite capacity ($6\frac{1}{2}$ cubic mm.). The filling of the automatic blood pipette is considerably facilitated and accelerated by holding it horizontally, instead of perpendicularly; that is, it is dipped sidewise into the drop of blood.

Since every trace of blood that clings to the exterior of the tube is to be considered a serious defect, it is necessary to smear the pipette with something of a fatty nature. This is best done by keeping it in a leather case, lubricated with tallow. As soon as the pipette is full the outer surface should be carefully examined. If a speck of blood is found there, it must instantly be removed, or before it has time to dry. This is done by means of a strip of filtering paper or absorbent cotton. The blood is then much more fully and easily absorbed when the exterior of the glass is coated with an oleaginous substance. Care should be taken that the column of blood ends at both extremities on the same level with the glass tubes, and neither with retiring nor with bulging, but with even extremities. If it should be necessary to use filtering paper or wadding to remove the blood from the exterior of the pipette, care should be taken that these substances do not approach too closely to the extremities of the blood column, in order to avoid a meniscus.

Even before these instructions are carried out, the various parts of the Hæmometer should be examined to insure perfect cleanliness, and a perfect condition of the apparatus. The component parts may then be arranged. The frame upon which the red glass wedge reposes must be joined to the wing on the lower side of the table slab, through which it finds its guidance. Moreover, the comparing vessel must be inserted into the opening designed for it in the table slab, and so placed that the

projection of the vessel, as observed from above, may coincide with the visible part of the free wedge lying beneath.

Both halves of the comparing vessel must be filled with distilled or pure spring water. The half above the wedge, called "wedge half," is completely filled with water from the pipette, so that the smooth surface which it forms above may be perfectly level, forming neither a positive nor a negative meniscus. The other, the blood half, is also filled with water from the pipette, but only to about one-fifth, or at most, one-fourth of its capacity. When this is done, the pipette out of which the vessel has been filled and which still contains a sufficient quantity of water to complete the filling of the blood half, should be placed in a horizontal position—*i. e.*, upon the brim of a goblet, so that the water will not flow out of it.

The pipette having been filled with blood, it should be brought (in a horizontal position) under the water in the blood half of the comparing vessel, when the little wire should be leaned against the upper edge of the vessel, but not against the straight edge of the partition wall, nor in either one of the corners at the end of the same, but against the middle point of the curved edge of the blood half. In this manner the little tube with the blood is made to lie in the centre of the rectilinear chamber, which the partition wall touches at the bottom of the vessel.

The blood pipette should not be permitted to remain quietly in that position under water, but a gentle motion should be imparted by a judicious guidance of the little wire to which the pipette is fastened; that is, the little tube should be moved backward and forward along its own axis as far as the dimensions permit, and in this manner be moved to and fro over its fluid contents.

It is easily seen that these movements are directed to produce a speedy solution of the contents of the tube with the surrounding fluid. It is also readily seen how important it is that no time be wasted in the proceedings following the taking of the blood, but rather that all should be arranged as quickly as possible without neglecting carefulness and exactness of execution. For the rest, the caution not to work more slowly than necessary, refers only to the manipulations. These motions are so easy and simple that even an unskilled hand will need not more than one minute for their execution. That much of time may pass without endangering the result in determining the amount of hæmoglobin.

All depends upon the blood being mixed with a certain quantity of water sufficient to dissolve it before it coagulates. The shorter and broader the capillary, the more rapidly the blood in the graduating capillary will mix with the surrounding water. The volume of blood used for measuring will be determined with greater exactness, the longer and narrower the graduating capillary is. The most advantageous length and breadth of the blood pipette is that which permits a rapid mixing of the blood and water with a sufficient exactness in determining the volume. My experience permits me to give a warning against the use of blood pipettes, however well gauged, which are shorter than 7 mm., or longer than 10 mm. Moreover, the edge of the blood pipette must be rounded, must be allowed to shape itself in the flame, but neither of the openings should be contracted nor narrowed.

As soon as most of the contents of the blood pipette has entered the water, the pipette should be withdrawn by the little wire and held in

a vertical position over the same, so that the lower opening of the tube in the centre of the blood half of the comparing vessel may be suspended several millimetres above the surface of the liquid. Then, with the other hand, seize the drop-pipette which has already been filled with water, and allow drop after drop to enter the upper end of the blood capillary. By this means not only the contents of the blood capillary, even to the very last traces of blood in the comparing vessel, are cleansed from it, but the traces of blood clinging to the surface of the capillary, and which were lifted from the comparing vessel, are again washed back.

If the drops which have detached themselves from the lower end of the graduating capillary are observed, it may be seen how rapidly the blood drops disappear, and how clear even the fifth or sixth of these drops is. This is also shown under a careful examination by a graduating tube perfectly clean, both within and without, perfectly smooth, and filled as well as washed with clear water. Care must also be taken that no concretions or foreign substances be on or between the coils of the wire which winds about the blood pipette and serves as a handle. Only when all is declared perfectly clean and free from blood, may the blood pipette be wholly removed from the comparing vessel.

The blood half of the comparing vessel, after the graduating tube has been rinsed, should not be much more than half full, never more than three-quarters full of the liquid, first in order to make a thorough mixing of the contents possible, and second in order to permit of a last stratum of pure water above the blood solution. This portion of water renders the overflowing of the partition wall an immaterial instead of a ruinous occurrence. The liquid in the blood half may now be moved with perfect freedom, a thin wire being used to stir it. In the absence of a wire, the handle of the blood pipette may be used; but in this case the loop which forms the end is an inconvenience, since it prevents the wire from reaching the corners at the bottom of the vessel. And exactly these corners, as well as the angles formed by the bottom and the walls, as also those formed by the partition wall and the mantle of the half cylinder, are the favorite sites of very concentrated parts of the solution. The particles of blood may be so slightly dissolved that no complete dissolution of the hæmoglobin in the water, and even no perfect destruction of the stromata of the red blood cells has taken place in order to secure the hæmoglobin in the solution, in consequence of which the liquid appears turbid. The angles and corners are to be noticed especially, and should be continually observed until neither inequality of color in the liquid in the blood half of the vessel, nor the slightest turbidness can be detected. This of course takes place while the light shines through it, since the vessel has already been set into the instrument (Hæmometer).

When these things have all been arranged, it is time to proceed to the filling of the blood half of the comparing vessel. It is not worth while to rinse back into the vessel the very small portion of the blood solution which clings yet to the end of the wire used to stir it. Pure water from the pipette is then dropped into the blood solution, care being taken that the liquid in the vessel is disturbed as little as possible. With a little practice it may be risked to allow the last quantity of water to flow in, instead of being dropped, while the end of the pipette

is dipped slightly beneath the surface of the liquid. The blood half and also the wedge half should be filled to the level of the rim, so that no meniscus may occur, but the liquid in both halves may have a common, absolutely level surface. Only in this case does the partition wall appear in the projection as a parallel limited black stripe, of a thickness corresponding to that of the partition wall. If the liquid in either half or in both halves has a meniscus (positive or negative), the dividing line appears distorted, widened in the centre or at both ends, cut by fine glistening white lines, also widened and following the line of the rim in several bands. In a similar manner a colored field, covered by a meniscus, semi-circular in the interior, and a distortion of the boundary with a contraction of the colored surface brought forward for comparison is discovered; although in a lesser degree, this is nevertheless still perceptible just as is the distortion which the picture of the partition wall suffers in consequence of a meniscus. This also affects the exactness and the reliability of the final result. The simplest method of avoiding this defect arising from the presence of the meniscus, is to bestow the requisite amount of attention and care in procuring a perfectly level surface of the fluids in each half of the vessel. Although this task may be disagreeable it should not be called difficult, since circumstances permit an approach to this end from both sides, and also since the transgression of the proper limit does no great injury. This of course is obvious in regard to the wedge half; for the blood half the same holds good according to what has already been said. Proceed with the same care in case withdrawal of the surplus liquid is necessary from the blood half. That is needed in adding the last portion of water to this half, as every current may lead to a mixing of the upper and lower layers of water. This surplus of water may be removed either by means of thin glass capillaries or by filtering paper. In either case avoid dipping too deep into the water. The wetting and overflowing of the partition wall may be avoided, when this edge has been greased beforehand.

A second method of eliminating the meniscus presupposes the fulfilment of the instructions given above. This method provides purposely a distinct meniscus for each half, or in case of the overflowing of the partition wall, which is here very probable, fills it until the whole surface forms a convex meniscus. Then place a small cover-glass over the opening of the vessel that no air bubble may be inclosed and without allowing the upper side of the cover to become wet. It is also necessary to avoid any approach to a stronger current in laying on the cover-glass just as one would reasonably regard the course of an expected current.

In the examination of human blood, notwithstanding the considerable quantity added, it is only on very rare occasions that merely an imperfect dissolution of the elements contained in the blood take place, and in consequence of which there is a certain turbidness of the liquid, so that a physician in his practice will scarcely ever find himself disturbed by this annoyance. On the contrary, in the examination of animal blood where red blood cells sometimes carry granules, one must be all the better prepared for an imperfect solution and a persistent turbidness in the water. In all such cases the rule of Mr. Leichtenstein is to add a minimum quantity of caustic alkali. This is an excellent rule. Indeed,

this investigator praises the effectiveness of fixed alkalies in almost imperceptible doses in every case of protracted turbidness of a stronger and more of a leuchæmic conditions of human blood. By this he refers to a pathological condition, where there is a decided increase of colorless (white) blood cells, and to the great resistance of the same to the effect of water. I know from experience only the clearing effect of this method in thinning blood whose turbidity is the result of the resistance of the granule conveying red blood corpuscles to the effects of the water.

The cases for which Mr. Leichtenstein recommends his method are very different from the cases in which I used his method with such excellent results, and I was not as yet in a position to observe the clearing effect in the thinning of the leuchæmia human blood. But this by no means deters me from unreservedly recommending this method in all such cases of protracted turbidity as have been investigated by Mr. Leichtenstein, and, of course, cases of leuchæmia and leucocythæmia may present themselves to a practising physician.

There are indeed conditions so simple and so universal that the certainty which the word of a reliable observer gives cannot be increased or diminished by repeated assertions.

The testing of a definite blood solution is a task of so great precision that in the unanimous reports of all the different universities conducting experiments, the various reports of one or more persons in the same blood test never varied more than one per cent.

The more deeply the blood solution to be tested is colored, and the thicker, accordingly, that part of the glass wedge which is of the same color, the more light the dull white reflector will throw through the comparing vessel.

If one is aware that the blood is normal it is best to give the reflector such a position that as much light as possible will be thrown upon the lower surface of the vessel. But in such cases where the thinner parts of the wedge are brought into use, that position of the reflector must be sought which supplies a sufficient degree of brightness.

The universal results from the Hæmometer are, the sharper and more exact the smaller the degree of brightness used in obtaining them.

The observing eye must be brought at a certain distance, perpendicularly over the comparing vessel, the other eye must be closed. It is also recommended to place between the observing eye and the comparing vessel, tilted upon the latter and standing upright upon the table slab of the Hæmometer, a cylinder of paper or pasteboard. The length of this cylinder must, of course, be suited to the sight of the observer. It will do no harm to have the inner surface of the cylinder painted black. The observance of the following rules is of the greatest importance :

The observer should not place himself in a position toward the Hæmometer such as he would, for example, assume in the use of the microscope, but should place himself in the same plane with the partition wall of the comparing vessel. The consequence of this is that the picture of both, according to their color and brightness, with comparative exactness semi-circles upon the retina, lie beside each other, not, as in other cases, one upon each other.

But the comparison of the degrees of brightness is much more exact when the impression is made upon the right and left halves of the

retina, than upon the upper and lower halves. Such is the case for the following reasons :

If one excludes the most peripheral portion of the retina in cases where there is a difference in the shape of the nose root on the temple side of the retina. The right and left halves of the retina of an eye are generally during the whole life affected by light and shade to the same degree. In other words, they are blended in the same degree, and consequently are equally sensitive to light. The upper and lower halves of the retina, on the contrary, are subject to the effect of light in essentially different degrees, in that the picture of the firmament, which in general represents by far the brightest part of the range of vision, is always wanting in the lower half of the retina. Thereby it is kept more nearly blinded ; that is, less sensitive to light.

The observer must also take care that the observing eye is not affected by rays from the light which illuminates the Hæmometer. For in this case, in consequence of the lights penetrating the tissues (tunice) of the eye, a similar inequality between the two sides or retina halves may result, such as we have just found in the halves of the retina lying one over the other.

The real work now is to focus the Hæmometer. This is done by moving the glass wedge by means of a large hand piece back of the column until the difference in the appearance of both halves of the comparing vessel has disappeared. This movement, as soon as the neighborhood of the real graduating point is reached, should be backward, and by short, quick strokes, rather than by a constant slow motion.

The paths of the wedge as it is shoved from one side to the other over the proper point should be gradually shortened ; in this way the distance traversed is lessened while the decision vacillates, until one has at last decided upon the graduation.

As it is advisable to look often rather than long into the instrument, so also when the graduation point is supposed to be determined the eye should be averted for a short time either by closing it or by looking at some dark surface, and then both halves of the vessel should again be compared. If there be the slightest doubt, the perfect equality of both halves should again be sought by short backward movements of the wedge, until at length further observation can detect no change in the decision either as to the purport or as to the exactness.

The sense of perfect exactness and unconditional correctness of the decision will be experienced in each case at the same time with the conviction that the greatest care and attention has been given. In the use of the Hæmometer, which is so simple that it must be intelligible, the conscience of the observer will in every case tell him of how much confidence he has made himself and his observations worthy.

But when the observer has been able to reach only a hesitating and unsatisfactory decision, it cannot always be attributed to want of conscientious care and attention.

There are persons who, although they are not exactly red blind, nevertheless have a retina very sensitive to long undulations of light, and to such persons the graduation of the Hæmometer not only presents a certain difficulty while it does not allow them to reach a positive conclusion satisfactory to themselves, but according to the few experiments of which they were hitherto capable, it seems that such persons graduate

the Hæmometer about one-fourth too low, that is in the examination of normal human blood at about 75 per cent:

Whether such persons can use the Hæmometer to advantage, and to what extent, and under what conditions, are questions to which the preceding experience can give no definite answer, and whose solution remains for future investigation. Still I wish to express, *a priori*, the following conjectures:

In those who are severely suffering with red-blindness whenever their retina are carefully studied and accurately observed, it is found that the same anomaly exists in all. Such cases afflicted with red-blindness manifest a functionary defect of the sense of color.

I consider the validity of the same course of reduction-quotients for the totality of the red-blind even more probable than the validity of the same quotient for the whole extension of the Hæmometer-scale, every graduation made by one who is red-blind in any definite direction upon the Hæmometer-scale, always through this, one quotient should be changed into the corresponding graduation of the normal eye.

The inability to see red in its proper degree of intensity seems to be a functionary defect of the sense of color, which occurs in all degrees between the normal eye and the total red-blindness. And I am not as yet convinced that in all the cases the defects extend to and spread wave-like or in a constant ratio over those lying within the defect.

Under such circumstances it seems to me to be highly improbable for red-examiners to have such a common factor of reduction such as we have observed for the total red-blindness may exist.

In contradistinction to the above-mentioned rare cases of eyes that are not at all able, or only to a certain degree able to use the Hæmometer, there are many observers whose sense of color is in the beginning, or at least after a little practice, so keen that they are able to detect with the greatest exactness the inequality of the coloring in the part of the wedge suddenly made visible through the comparing vessel. Of course the difference in the thickness of the wedge at both ends of a piece in a position of the same visible at the same time is not less than 0.9 mm., therefore the difference in the graduation of normal human blood amounts to about 18% of the central thickness of the wedge. Yet it has been said that every observer is not capable of detecting the corresponding variation of the color in the thickness of the red glass. Together with the ability to distinguish such slight differences in the intensity of the color, there is combined a real advantage in the use of the Hæmometer. Such observers are able in graduating to seek that position of the wedge in which at the end of the partition wall of the comparing vessel the blood half is more deeply colored than the wedge half; at the other end the wedge half appears darker than the blood half. Between these there must of course be a point at which the intensity of color is the same on both sides of the partition wall, and this point must be in the centre of the partition wall if the increasing variations are alike at both ends. To carry out this arrangement the division of both halves of the colored circle into three subdivisions (so that there are six in all) by means of two thin black straight lines perpendicular to the dividing line and dividing the latter into three equal parts, is advantageous.

I believe that I not only anticipate correctly the surprising effect

which these directions for the use of the Hæmometer will probably have upon the most of my readers, but that I will also find this impression well founded by the evident incongruity between the small number, the simple character, and the rapid execution of the proceedings demanded in Hæmometer measuring on the one hand and on the other, great number of rules and instructions which I have given above. Since all should be alive to the importance of the cautionary rules for the correct execution of these proceedings, it cannot be otherwise than that every one will find in these instructions much that he already knows or considers self-evident, but it may also be that each will find something new or something which he himself would not have arrived at. The purpose in giving at length these rules is to enable each possessor of a Hæmometer to use it without fruitless attempts. In the very beginning he should make useful and reliable measurements. The purpose could be fully carried out only by a complete enumeration of all possible rules that might be considered.

Detroit Meeting of the American Society of Microscopists.

BY G. E. FELL, M. D.,

BUFFALO, N. Y.

Owing to the terrible calamity at Louisville where the meeting was to have been held, and at the request of the Louisville Microscopical Club, a change in location of meeting is made, and a cordial invitation of the Detroit microscopists has been accepted. The next meeting of the Society will, therefore, be held at Detroit, Mich., beginning August 12, 1890, and lasting four days. The sessions will be taken up, to a great extent, with the reading and discussion of papers. Special features of each meeting are the President's Address, the Working Session, and the Microscopical Exhibition. The manufacturers' exhibit of apparatus, slides, etc., is generally very extensive.

This Society was organized at Indianapolis, Ind., in 1879, and is now in its second decade. Successful meetings have been held at Buffalo, Detroit, Columbus, Elmira, Chicago, Rochester, Cleveland, Chautauqua, Pittsburgh, Columbus, and Buffalo, in the order given.

Each year a volume of proceedings, furnished free to the members, and consisting of from one to four hundred pages, has been issued. Some most valuable contributions have appeared in these volumes. Among these may be mentioned the record of the life-work of Chas. A. Spencer, Robert B. Tolles, names inseparably connected with the advance of microscopy; the memoir of Prof. Hamilton L. Smith on the Diatomaceæ; of Prof. Wm. A. Rogers on Micrometry, and many others. Most every branch of microscopical investigation has been reported in the pages of the proceedings. The results of the past ten years has demonstrated the great value and need of the Society in upholding and placing on record the work of American microscopists. To non-attendant members the proceedings will give a full account of the meeting, and should be a sufficient inducement to add greatly to the membership.

The advantages of attendance, as may readily be seen, are very great. Usually a good percentage of the members attend.

The admission fee is three dollars, and the annual dues, which have sufficed to carry on the work of publication, to pay for extensive researches in micrometry, and to meet the ordinary expenditures of the Society, have been kept at the moderate sum of two dollars. As the annual fee entitles the members to a copy of the proceedings, worth in some instances more than this amount, it is reasonably urged that all workers with the microscope should secure membership.

Application for membership or inquiries may be made to the President, Dr. Geo. E. Fell, Buffalo, N. Y.; Vice-Presidents Prof. W. H. Seaman, Washington, D. C., and F. W. Kuhne, Esq., Fort Wayne, Ind.; the Secretary, Prof. T. J. Burrill, Champaign, Ill.; the Treasurer and Custodian, C. C. Mellor, Esq., Pittsburgh, Pa., or to the members of the Executive Board, Dr. W. P. Manton, Detroit, Mich.; Dr. F. L. James, St. Louis, Mo., and W. H. Walmsley, Esq., Philadelphia, Pa., these gentlemen constituting the officers of the Society.

It is, perhaps, needless to state that the active microscopists of Detroit will provide ample entertainment to the Society, and that reduced rates of travel will be provided for all who attend. The scientific aspect of the meeting is already assured, as more than a score of valuable papers have been promised.

How to Clean Old Slides and Utilize Spoiled Mounts.*

BY DR. H. M. WHELPLEY, F. R. M. S.

For two years past I have permitted soiled slides and spoiled mounts to accumulate in a box set aside for that purpose. The process I have recently followed in reclaiming them has been successful.

I first placed the unsightly rubbish in a dish of clean water where it remained until all of the labels were readily removed; with an old knife I next scraped off the cells and all cement that could be easily removed in this manner. All slides where glycerine or other substance soluble in water had been used as a mounting medium were again washed, and then the entire pile spread out and dried. I separated those that were clean and placed the rest in alcohol for several days. This solvent cleaned another portion of the slides so that all they required to render them as good as new was a washing in water. The remaining dirty ones were treated to a bath of oil of turpentine, where they rested for a few days. From this they were washed with alcohol and then finished in water. The few refractory ones that held out during all this time were made as clean as ever with benzol.

Although considerable time elapsed before the last slide was cleaned, it required but a few minutes of actual labor in the entire process. The time consumed is in letting them stand in the different liquids. Nor is the process expensive, as the oil of turpentine did most of the work. Hereafter I shall divide my old slides into three classes and clean them separately so that less alcohol will be required. The first box will contain slides that can be washed clean with water. The second lot will be those that alcohol will clean, and the third the ones requiring benzol.

Cover-glasses are so cheap that I do not save them unless they are easily cleaned with water. I find it very difficult to properly clean thin cover-glasses that have cement on them.

* Read at the St. Louis Club of Microscopists.

Is there a Science of Microscopy?

• BY WM. H. SEAMAN, M. D.,

WASHINGTON, D. C.

The words "science" and "scientific" are often used with very loose and indefinite notions of their meaning. In general, science is certain knowledge, the total written record of the observations and opinions of men trained in investigation, and logical in habits of thought. In particular, it means that part of such record as relates to one single class of closely related phenomena, as of light, the science of optics.

When the worker or investigator requires a knowledge of several different parts of science or sciences, which co-operate to enable him to produce a given result, such a collective body of knowledge of different kinds constitutes an art, as the art of medicine or of painting. Now in the telescope and microscope we have two instruments, each of which, in its own place, has equally aided in scientific research. The word telescope has the same form of derivatives, telescopic, telescopical, as microscope, but in place of telescopic we say astronomy.

Nobody questions the right of astronomy to be called a science, but it includes a knowledge of the instrument used, *i. e.*, telescope, and also of the things observed. The telescope is chiefly applied to celestial bodies in regard to which our powers are limited to a few characters, as size, distance, etc., while the microscope gives us a much greater variety of knowledge. If, however, we consider the applications of the latter instrument, we shall find it chiefly employed in examining the simplest forms and elements of organic life, and this is pre-eminently the field in which skill in the use of the instrument and knowledge of the thing observed go hand in hand. Here then is the basis of the science of microscopy as a definite branch or division of human knowledge, as accurately and well defined as astronomy.

Histology, the Protozoa and Cryptogamia, together with the technics of the instrument are the principal and particular subjects included under the more general term "Microscopy."

Certain other subjects are partially but less perfectly covered, as embryology, physiography, etc., because they involve in their treatment both macroscopic characters and ideas, chemical or otherwise, not microscopic. But the parallel with astronomy still holds good, for that science has, likewise, side or auxiliary branches, as spectral analysis, stellar photography, etc.

The use of the words "microscopy" and "microscopical" to indicate a particular science, is not only justified by the above parallel, but also by usage, which has much to do with fixing the meaning of terms, and, when fully established, dominates other considerations in the use of language. From the time when the compound microscope was made in its modern form we have had numerous societies, periodicals, and text-books, of the highest scientific value, in the titles of which the words in question are used. If we examine the character of this literature, we shall find it corresponds to the above statements. The Royal Microscopical Society of London publishes a journal which contains abstracts of all current microscopical literature as well as its own transactions. Less than half of the papers in the "Transactions," and a still smaller proportion of the "abstracts," relate to microscopical technics. The abstracts are classified in the index under the various

subdivisions of Zoölogy and Botany to which they belong. The subject-matter of these abstracts may be considered to fairly represent microscopical literature and the science of microscopy.

In the previous remarks a parallel has been drawn between astronomy and microscopy, as having equal claims to the title of science.

But if the mixed nature of subject-matter lessens the claim of a pursuit to the title of Science, Geography, as the term is usually construed, has far less claims to be called a science than microscopy.

Until recently the applications of the microscope were almost entirely confined to living structures in their minute elements, or a special part of Biology, but "Geography as a science," as defined by Webster, includes more or less Astronomy, Politics, and Biology; in a word, as heterogeneous a mass of subjects as could well be assembled.

Neither can it be said that Botany, as commonly understood, includes all the results obtained by the use of the microscope, nor, similarly, that Zoölogy covers all the microscopical work belonging to the lower forms of animal life. The great majority of those students called botanists in this country know almost nothing of the use of the compound microscope in its more perfect forms, or of the lower classes of vegetable life. The same is true of numbers of zoölogists, and in these lower classes of living forms we tread so closely on indeterminate boundaries of form and structure that the distinctions between plants and animals cease to be of more value than species characters in higher groups, as illustrated by Hæckel's idea of the class Protista. Here again the parallel with Astronomy holds good. Spectral analysis and stellar photography are often classed as branches of Astronomy, but they belong by nature to Chemistry, and the bond of union to Astronomy is the principal instrument employed, as much as the subject-matter.

It may be further pointed out that no man is a competent observer in the field of microscopic zoölogy or botany who is not well acquainted with both classes of objects. Their habitats and forms are so similar as sometimes even to render it a matter of doubt as to which department of life they should be assigned.

This application of the microscope presents so much adapted to interest the observer that men are fascinated with its study apart from any pecuniary reason. Men who begin scientific work because they love it frequently acquire the highest skill in their speciality.

They find their highest pleasure in the pursuit of science in the sense defined at the beginning of this article, as a body of knowledge based on inductive reasoning. The essential conditions of this pleasure are enthusiasm for truth, and a judicial temperament that takes nothing for granted unsupported by a logical basis of reasoning. When to these we add the power of projecting on the mental plane of vision combinations of ideas hitherto unknown, (called by Tyndall "the scientific imagination") we have the conditions of greatest success in its pursuit.

These conditions are as likely to exist in the so-called amateur, as in the man who makes science his business.* Many attempts have been

*Amateur, "one who cultivates any study or art from taste or attachment, without pursuing it professionally."—*Webster*. This word does not in any way include the idea of careless, incorrect, or imperfect work.

See articles on the above subject in *Zeitschrift für Mikroskopie, ueber die Entwicklung und gegenwärtigen Stellung der Mikroskopie in Deutschland*. Edouard Kaiser, October, 1877.

Also *American Quarterly Microscopical Journal*, vol. 1, p. 58, 1878, and *Journal Royal Microscopical Society*, Jan., 1879.

made to define the term "Amateur," as distinct from the professional man, but so far entirely without success. So far as microscopical work is concerned, the expense and time required will prevent any from engaging in it who have not a real love for it that will tend in any case to a higher plane of intellectual character, if not to substantial contributions to knowledge.

But on the latter point, many of the most important additions to our scientific literature have been made by men who were amateurs, if that term is applied to men who do not make a business, or gain a livelihood, by the exercise of science. Rutherford, Tulasne, Dallinger, Wolle, Strecker, etc., are amateurs, and the character of their contributions to microscopy and other sciences fully justify the admission of amateurs to consideration as scientific men and fellow-workers for the increase of our knowledge of absolute truth.

Aniline Stains for Microscopic Objects.*

BY HERR HUEPPY.

The basic aniline colors are soluble in water, and for the most part in one or all of the decolorizing agents in use a weak watery solution colors at first the intercellular substance and the cell body, while the nuclei remain unstained. Through the subsequent treatment with alcohol, glycerine, or acetic acid an inversion of the staining takes place, by which the elements previously colored become colorless and the previously colorless nuclei are stained. In the use of the stronger solutions the staining follows (without any discernible inversion) directly and quickly, and, in general, its intensity is in proportion to the concentration of the solution. In a quite concentrated watery solution over-staining may occur, which can be reduced to the proper degree by subsequent decolorization.

If the dyes are dissolved in the decolorizing agents—such as absolute alcohol, acetic acid, or thick glycerine—they stain slightly or not at all. Instead of using some decolorizing agent subsequently to reduce the intensity of the staining to a proper degree in preparations which have been overstained in watery solutions, in many cases a solution of the dye-stuff in a mixture of water with alcohol (Hermann), glycerine (Schaefer), or acetic acid (Ehrlich) may be used.

The basic aniline dyes are used in the following solutions:

(1.) Concentrated watery solutions. These are either used directly, or after dilution to the desired degree with distilled water. The solutions are prepared with distilled water (which has been previously boiled), so that an excess of the coloring-matter remains undissolved. They must always be filtered before using. Only a small quantity of these watery solutions should be made at a time.

(2.) Concentrated alcoholic solutions. The solution of an excess of the coloring material is brought about in the best way by absolute alcohol, or, in want of this, by the officinal 90 per cent. spirit of the Pharmacopœia.

In general, one can calculate about 20 to 25 grammes of the dye-stuff to 100 grammes of the spirit or alcohol. These solutions are kept pre-

* "Die Methoden der Bakterien-Forschung."

pared, and are not used directly for staining, but are mixed with a certain amount of distilled or aniline water. In place of concentrated watery solutions the alcoholic solutions can be used if five or six drops are added to a small watch-glass of distilled water. This mixture is often designated as the dilute alcoholic solution. From the watery or alcoholic solution of the basic aniline colors the various staining fluids are prepared. The preparations that are more commonly employed in staining bacteria are Koch-Ehrlich's solution of methyl-violet or fuchsin, and the alkaline methylene blue solution.

A New Diatom Mounting Medium.

By F. W. WEIR,

NORWICH, CONN.

$C_{10}H_7Br.$ + Resin of Tolu.—Dissolve 3 oz. of commercial balsam tolu in 4 fl. drams of benzin (C_6H_6) at a temperature of about $45^\circ C.$, and strain. Add 4 fl. oz. of carbon bi-sulphide, agitate thoroughly and allow to cool, when the tolu solution will separate and the carbon bi-sulphide with cinnamic acid in solution can be decanted. Add another portion of carbon bi-sulphide and treat as before. Finally pour the tolu solution into a glass tray and evaporate the benzin. Place in a $\frac{1}{2}$ oz. glass stoppered phial 1 fl. dram of naphthalin monobromide and add gradually about three times its volume of the resin of tolu, or sufficient to make the mixture quite stiff when cold. The solution will be effected slowly at about $45^\circ C.$ The above constitutes a mounting medium which is rather easier to use than Canada balsam.

Warm the medium at 40° to $45^\circ C.$ until quite fluid, take up a minute quantity on a warm needle, place on centre of cover-glass and invert on slide. Use no pressure whatever, but warm the slide gently, when the medium will flow to the edge of cover.

After a few days ring with a non-alcoholic cement. This method of treating balsam tolu does not remove an atom of resin and does not allow an atom of cinnamic acid to remain. The subsequent solution in naphthalin-monobromide produces a medium of higher index (1.73) than the resin alone, permanent in structure and volume, and free from objections to which any medium in a volatile solvent is subject.

Cleaning Diatoms.

By J. J. MOLES,

YARMOUTH, ENG.

Having had a little experience in cleaning a large number of different earths, I have found that each deposit requires a special treatment; but as a general rule, the following will prove useful: First boil material in hydrochloric acid for two or three minutes in test-tube; allow to settle, pour off the clear portion, and substitute nitric acid, of course, both pure. Boil again for two or three minutes, then wash well in distilled water in a tall beaker, allowing the sediment to settle; repeat the washing till all acid is removed. Now examine on slide. Should the deposit not now be clean, boil with a small portion of soap; this removes a lot of "flock." Wash again to remove the soap; then decant, and add liquor ammonia (fort.) for 20 or 30 seconds. Lastly, wash well in distilled water; this leaves the pustules sharp and brilliant.—*English Mechanic*, Dec. 6, 1889.

MEDICAL MICROSCOPY.

“The Diagnostic Value of the Phosphates in Pregnancy.”—The method used by William B. Gray, M. D., of Richmond, Va., for precipitating the phosphates is, by adding to the urine in a test-tube about one-third its bulk of magnesium fluid, composed of one part each of sulphate of magnesia, chloride of ammonium, aqua ammonia, and eight parts of water.

What most interests us, however, is the microscopic appearance of these crystals, for by it can be made the diagnosis of pregnancy weeks in advance of other signs in that condition. One should be thoroughly familiar with the details of the normal crystals before attempting to recognize any departure therefrom.

The normal triple phosphate is precipitated in those beautiful feathery crystals, sometimes a single leaflet, or in stellate forms; but, however seen, each feather is perfect. If only a fragment is observed, the feathery appearance is preserved to its extreme tip, equally clear on each side of the central stem.

As soon as conception occurs, the appearance of the triple phosphate changes. It begins to lose its feathery appearance, and disintegrates. The change commences at its tip, and progresses toward its base; or, only one side of the leaflet may be affected, leaving the other intact. As the disintegration progresses, only the bare stem may be left, with perhaps a few scraggy points jutting from its sides, and even these stems broken into bits with scarcely any mark to identify them as triple phosphates. These changes commence in the phosphates within twenty days after conception, and continue for several months. After the middle of the seventh month these changes become less pronounced, and gradually approach a more normal type up to the end of gestation.—*American Practitioner and News*, March 29, 1890.

Bacteriology in Johns Hopkins Hospital.—The instruction in Bacteriology is under the charge of Professor W. H. Welch and of Dr. A. C. Abbott, assistant in Bacteriology and Hygiene.

The rooms for bacteriological work are in the Pathological Laboratory, and are supplied with all of the apparatus required by modern bacteriological methods, such as those employed in the Hygienic Institute in Berlin. The laboratory has a full set of cultures of pathogenic micro-organisms, and of others useful for study and teaching.

Opportunities for studying bacteriology are available for students during the entire academic year, the laboratory being open on week days from nine o'clock in the morning until six in the evening. As much time can be given to the work as the student has at his disposal.

In the bacteriological course the student becomes familiar with the preparation of the various culture media, with the principles and methods of sterilization, and with the morphological and biological characters of the micro-organisms which belong to this department of study, particularly with those which cause disease. The methods of making biological examinations of the air, water, and soil, are taught.

Facilities are afforded to those who are prepared to undertake original investigation in bacteriology.

Dr. J. E. Reeves, of Chattanooga, is professor of pathology, histology, and microscopy in the new U. S. Grant University, which has been formed by the union of the Grant Memorial University with the Chattanooga University.

EDITORIAL.

Aristocracy Among Scientific Men.—Of course we all know that persons of high social standing and those who thus rank among the aristocracy may, and often do, become noted men of science, but we are not now to discuss that fact, as the above title might seem to demand.

But do you know that there are among scientific workers two classes, the one recognizing, in a broad way, all other scientific workers as equally engaged in scientific work with themselves, and the other class claiming themselves to be of the simon-pure brand while denying that characteristic to some of their fellow-workers who labor in newer or different fields? In other words, have you observed how each new science gets put through a sort of "survival of the fittest" process at the hands of the very men (scientists) who, most of all, would naturally foster a new science? Perhaps it is on that principle by which a parent, with high ideals in view, chastens its child at least until the latter gets big enough to resent chastisement.

Now all this signifies that we, as microscopists, must stand up bravely under the snubbing process, until we are big enough to whip our kind parents out of their aristocratic notions towards us.

In Washington we have a Philosophical Society, a Biological Society, an Anthropological Society, a Chemical Society, a Geographical Society, a Microscopical Society, and some others. There has just been published a "Directory of Scientific Societies of Washington," comprising the five first named, and not including the Microscopical Society. Any outsider seeing this pamphlet will conclude that there are no scientific societies in Washington worth mentioning outside these five. The pamphlet is published by a "joint commission" of fifteen composed of three delegates from each of the "component societies," and these gentlemen have carefully entitled their pamphlet "Directory of Scientific Societies." They do not say of *the* scientific societies, which would assert that there are no others, neither do they say of *some* scientific societies, which would imply the existence of others; but they hedge with the above phrase, although knowing that strangers will infer that there are no other scientific societies here. By personal inquiry we learn that the question of admitting the Microscopical Society to representation has been discussed among them, and that "some of the gentlemen did not consider it entitled to rank as a scientific society, nor microscopy to be recognized as science." Whether the high joint commissioners from the Geographical Society were the ones who had no doubts about their own position, and were fearful about Microscopy, we are not informed, but we will open our columns to any one who wishes to show Geography to be more a science than Microscopy. We will still further throw down the gauntlet to the anthropologists, and invite them to show wherein Anthropology is a science and Microscopy not equally so. But, as the microscopists are all ready to begin the discussion, we present in this issue some views as formulated by Dr. Wm. H. Seaman, who, being a prominent member of both the Biological and Chemical Societies, has certainly been recognized by them as a scientific man.

The writer of this editorial happens to be a member of the three oldest

societies, the Philosophical, the Anthropological, and the Biological. So do many others of our Microscopical Society belong to one or more of the five societies, such as Prof. Hitchcock, Dr. Thos. Taylor, Dr. Acker, Dr. Reyburn, Mr. V. A. Moore, Dr. Lamb, Prof. Burgess, and others.

Perhaps, then, we are far along toward recognition, and need only to make our work better known and to be patient. Of course we must not allow our kind elders to keep us in Knickerbockers any longer than they fit, and we suspect that they set terribly tight now.

The American Association for the Advancement of Science recognized microscopy as a branch of science over 10 years ago, and made it a section. Microscopy seems even then to have been a science. For our own part we very much regret that the section was abandoned in the interest of a separate national society. Tell us, gentlemen, who organized the American Society of Microscopists, whether or not you organized a Scientific Society, and, if so, what are the grounds and proofs of your claim?

— o —

Weir's Mounting Medium.—A monobromide compound has been discovered for mounting diatoms, which will probably prove of exceptional value. It has none of the defects of the bromide of antimony and glycerine compound. The latter is difficult to seal so as to preserve the cement. This tolu and monobromide compound has an index high enough for all ordinary mounts. Prof. Smith, of Hobart College has given it a thorough trial, and says that it is the best medium he knows for diatoms. The inventor most generously throws open his knowledge for the use of all, and does not expect to reap any pecuniary benefits from the sale of this medium. It is some trouble to prepare this compound, and as the inventor does not expect to prepare it for sale, we hope that the dealers in microscopical goods will at once do so.

— o —

Slides Received.—We return thanks to the donor for the following interesting slides: Three specimens of fresh-water sponges, *Carterius tubisperma*, *Meyenia plumosa var. palmeri*, and the robust form of *Spongilla lacustris*. These slides present a beautiful appearance and are equal to anything that we have yet seen. The cement rings are of transparent colors and closely resemble bevelled glass. Prepared by Prof. C. H. Rowley, Westford, Mass., in March, 1890.

— o —

We also return thanks to the donor for the following interesting specimen: Diatomaceous earth from Wyoming Territory, sent by Mr. W. H. Bullard, St. Paul, Minn.

— o —

Slides Received.—We desire to return thanks to the donor for the following interesting slide: *Surirella* (Diatom), prepared by Mr. A. F. Bartges, Akron, Ohio.

— o —

We also return thanks to the donor for the following interesting slide: Polyzoa, prepared by Dr. J. D. King, Edgartown, Mass.

NOTES.

King's Cements.—It is gratifying to note the favor with which Dr. King's cements are meeting. They are not fancy preparations of uncertain value, but are adapted to all practical microscopic mounting. The red "lac cell and finish" is particularly adapted to deep cells, and the transparent and white zinc to thin ones as well as to the finishing of the mount. These cements are economical, they run smoothly and are very useful for excellent work.

To Mount the Tongue of a Fly.—J. E. Huber gives the following method: The insect should be beheaded with a sharp instrument and the head immediately immersed in liq. potassa. After a few days soaking the tongue will be seen protruding. Then wash and mount in the usual ways. Staining may be done with carmine to bring out the details.

Mounting Media for Perishable Crystals.—Prof. Johnson, of Johns Hopkins University, recommends, as adapted to this purpose, one of the following: 1. Finest copal resin dissolved in chemically pure amyl alcohol. 2. Finest copal dissolved in pure absolute alcohol. 3. Damar resin dissolved in rectified spirit of turpentine. No heat should be used in making these solutions, which should be very thick fluids. 4. Damar resin dissolved in balsam copaiba. 5. Boiled chian turpentine dissolved in balsam copaiba. 6. Damar resin boiled until the rising scum becomes nearly dissipated, the remaining scum to be removed with a spoon.—*Pharmaceutical Era*.

Paris Exhibition, 1889.—The following English opticians obtained rewards at the last Paris Exhibition, though not necessarily for microscopes alone:

Grand Prize.—Messrs. Ross & Co.

Gold Medals.—Mr. J. H. Dallmeyer, Mr. J. Pillischer, and Messrs. Watson & Sons.

Typographical Errors over the word Microscope.—The Journal of the Royal Microscopical Society for February, calls attention to the "Orthography of the Microscope," citing a series of errors it has noticed, and remarking upon them as follows:

There is no word which is so variously spelt as "Microscope" or (with "Microscopical," &c.) so often misspelt by printers. The form "Miscroscope" occurs times out of number. The Germans, apart from the standard form of "Mikroskop," also spell it "Mikroscop," "Microskop," and "Microscop." "Mikrospischen" is found in Stenglein's "Anleitung," 1887.

"Microscrope" appears in Proc. Amer. Soc. Micr., 1886. "Miros-copical" in Amer. Mon. Micr. Journ., viii (1887), p. 49, and in Journal Royal Microscopical Society, 1887, p. 1039. "Microscopial" in "The Microscope," 1888, p. 108. "Mikrokopiker" in "Flora," 1888, p. 39.

Breath-Screen.—In snub-nosed persons, says Dr. P. Schiemenz, the expired air tends to pass down parallel to the tube during a microscopical examination. The deposit of moisture, especially in winter, is sometimes annoying, and to obviate this the author recommends the

adoption of a screen. This may be made of a piece of stiff paper, the principal part of which is nearly circular (diameter about 8 cm.). The smaller portion is pierced by two holes, through which passes a string by which the apparatus is attached to the microscope-tube. This breath-screen can, of course, be easily fixed in or moved to any position.—*Jl. Royal Micr. Soc., Feb. 1890*, p. 94.

Dr. James E. Reeves, of Chattanooga, Tenn., is devoting special attention to microscopical diagnosis and examination of tumors and other morbid tissues, secretions, and excretions. He also receives students in microscopical technique, histology, and pathology, including use of microscope, microtome, etc., and has for sale typical mounts in large variety.

QUERIES.

Q. Is there any blank catalogue published which is properly arranged for cataloguing and indexing microscopical objects?—*W. C. B.*

A. **The Alling Record Book**, entitled "Microscopical Records," contains, in addition to numbered spaces for 500 or 1,000 preparations, from 20 to 40 pages of paper ruled for formulæ, so that they can be referred to by number, and avoid repeating the details with each object. The plan of entry is based on one presented by Prof. S. H. Gage, of Cornell University, at the meeting of the American Society of Microscopists held at Chicago in 1883. It has been revised somewhat by Mr. Alling. The slides are to be catalogued by the common name, scientific name, locality obtained from, obtained by, mounted by, special object of preparation, method of hardening, staining agent, clearing agent, mounting medium, date, and remarks. As there are only three entries to the page, plenty of room is left for each fact. The paper is nicely ruled, the division between the slides being with red ink.

There is an index sufficiently large for cataloguing each preparation under both the common and the scientific name. It can also be used as a record of all objects contained in an entire cabinet. The small size in one-half Russia costs \$3.00, while the one twice as large and in same binding, costs \$5.00.

This book is published by Chas. E. Alling, of Rochester, N. Y., and sold by G. S. Woolman, 116 Fulton street, New York. For special rate to our subscribers only see advertisement.

Ward's Microscopical Slide Catalogue.—This is the invention of Dr. R. H. Ward, of Troy, N. Y., and has resulted from the author's effort, during more than twenty-five years, to make a collection of several thousand slides useful, in teaching as well as in study, to the greatest possible extent, and at the least cost of time and labor. It consists of a combined serial and alphabetical Catalogue, with an Appendix for special notes, etc. The systematic series of blanks, arranged by tens upon the pages for ready reference, is calculated to contain as full a record of important data concerning the slides as can be secured without destroying its convenience as a catalogue. The set form, which secures completeness and uniformity of description by calling for a large number of specified data, is printed only as a heading at the top

of the pages, by which means the record of each slide is uninterrupted, and opportunity is given for the substitution of other data according to the habit or preference of each student. By entering promptly every slide prepared or otherwise obtained, and recording such data as may then be known concerning it, or as may happen to be acquired afterward, much useful information will be saved, and the value of any collection, whether large or small, will be greatly increased.

Copies can be obtained, carriage paid, from the author, at the cost of \$4.00 for 1,000 slides, \$6.00 for 2,000, \$8.00 for 3,000, \$10.00 for 4,000 in two volumes, and for larger sets \$3.00 for each 2,000 of additional capacity.

Focussing the Chemical Rays.—Q. Is not the chemical focus, on account of the greater refrangibility of the chemical rays, *nearer* the objective than the visual focus, and should not the objective be moved nearer to the object in order to throw the chemical focus back to the screen? This may not be very important, as a lens perfectly corrected for chromatic aberration would probably render the chemical and visual focus nearly or quite coincident.—J. M. Edwards. A. The correspondent is quite right in his suggestion that the focus of the chemical rays is nearer the front of the objective than the focus for the more luminous rays, on account of their greater refrangibility. Nevertheless, my own statement is correct, that the objective must be withdrawn from the object to focus the chemical rays on the screen. For with the ordinary over-corrected objectives the focal plane for the actinic rays is further away than that for the other rays.—R. Hitchcock.

MICROSCOPICAL SOCIETIES.

WASHINGTON, D. C.,—L. M. Mooers, *Sec'y*.

103d Meeting, March 25.—A paper was read by Dr. V. A. Moore, on micro-organisms in urine, with special reference to those forms which cause its ammoniacal fermentations. He exhibited plate and tube cultures showing the characteristics of growth and development of these bacteria and their action on culture media. Dr. C. H. Stowell, late of Ann Arbor, Mich., and founder of *The Microscope*, was elected to membership.

104th Meeting, April 8.—The Life History of Micro-organisms, with its Relation to the Theory of Evolution, was the subject of a paper by Dr. Robert Reyburn. The paper was full of interest, and the discussion which followed was participated in by Dr. C. H. Stowell, Dr. Thomas Taylor, Dr. V. A. Moore, and Dr. Reyburn.

SAN FRANCISCO, CAL.,—Wm. E. Loy, *Sec'y*.

March 26, 1890.—The secretary reported the usual additions to the library of periodicals and proceedings, including *The Quarterly Journal of Microscopical Science* for February. R. H. Freund and John D. Coulie were elected active members and the application of Dr. E. S. Clark was received.

The paper of the evening was by Carl H. Eigenmann, Ph. D., on "The Genesis of Chromatophores in Fishes." Mr. Eigenmann has

made a special study of the life of fishes. By way of introduction he mentioned how the color of fishes varied under different conditions: the color of the food would modify it, or the color of the bottom of the sea where the individual made its habitat would change it. The same species, under these varying conditions, would show a marked difference of color in tide pools separated but a few feet. In this latitude most fishes frequenting our shores and coming near the surface are a dove color. The species found at a depth of 200 fathoms or more are plain black or plain white. Farther south they assumed a brighter hue. Professor Alexander Agassiz obtained different colors in the same fish by changing its surroundings, or by placing it over sand of different colors.

In order to fully explain the formation of the chromatophores or color cells, the speaker gave a brief outline of the development of the fish, its embryology. A number of carefully made drawings supplemented various preparations shown under the microscope, and the various stages of the embryo were drawn on the black-board. The pelagic ova, being lighter than the sea water, float to the surface and there pass rapidly through the various stages in the embryonic state. Most of the observations noted were made in the vicinity of San Diego, and were confined to the ova obtainable in or near the harbor, as he had nothing but a row-boat in which to make his excursions, and it was not possible to go long distances, gather and convey them to his laboratory and note the rapid changes.

Rider first called attention to the origin of color. At fourteen hours, he says, the embryo begins to show signs of the development of the pigment just below the superficial layers of the epiblast. These cells are at first scattered irregularly over the body of the embryo, and gradually grow darker. As they do this they also become irregular in form and flattened, with a number of points running out from them. Later they tend to aggregate on certain parts of the body. The rearrangement appears to be accomplished by their migration toward definite points, by means of an amœboid movement of their entire substance. By the time the young fish is ready to hatch, the covering of the oil sphere is found to be more or less covered with pigment, which seems to have in part developed in the cellular mantle.

Agassiz and Whitman give a more satisfactory account in describing the early stages of *Cottus grænlandicus* and *Motella argentea*. Of the first they say the pigment is at first extremely pale, and confined to a few mesoblastic cells along each side of the embryo. In the course of an hour the number of young pigment cells is much increased, and a few black pigment dots make their appearance. By this time some of the pigment cells of both colors have wandered away from the lateral mesoblastic masses of the embryo, and appear as isolated amœboid cells, between the ectoderm and the layer which we have called the periblast. In *Motella*, pigment cells first appear near the closing of the blastopore, and they are developed along the sides of the embryo from the blastopore forward.

Pigment is nearly always found sometime before hatching, and as the embryonic life is usually short, lasting from eighteen to forty-eight hours, and the eggs are transparent, the whole process, from fertilization to hatching, can be observed without any very great inconvenience.

The observations recorded were all made on the living egg, which was usually placed under a cover-glass, which was supported either by wax feet or paraffine rings.

Mr. Riedy exhibited a wide-angled condenser in a new mounting, made by the Bausch & Lomb Optical Company. This mounting has an iris diaphragm, opened and closed by a lever, completely controlling the light, and a rack and pinion decentring attachment. The dark-field stops and the blue glass are quickly changed, the supporting ring swinging aside for that purpose. The convenience of manipulation and its very neat appearance were admired by all.

NOTICES OF BOOKS.

How to Use the Microscope. By John Phin, 12°, pp. 238. Illustrated with eight plates and numerous figures. J. W. Queen & Co., Philadelphia. (Price, \$1.00.)

Ever since the publication of the first edition of this volume it has been a favorite with the experienced microscopist as well as with the amateur. It is still intended to meet the demands of beginners, and has lost nothing of its elementary character. It is practically a hand-book to the microscope. For all those who wish to know how to select a compound or simple microscope for practical purposes, learn the technical parts of the instrument objectives, their tests and kinds, all accessory apparatus, manipulation of light both for transparent and opaque objectives, this book will be found to answer nearly every question that may arise. One of the most interesting features is the instructions for collecting objects, their preparation, preservation, and mounting for examination; together with preservative mediums, cements, and varnishes.

Mr. Phin's well-known book on the microscope has been out of print for nearly two years, and the present edition with its various corrections and increased number of plates justly deserves to find a cordial welcome.

A Short History of the Roman People. By William F. Allen. 12°, 370 pp. Ginn & Co., Boston. (Price \$1.10.)

In this neat little work Professor Allen set out to relate briefly the history of the Roman people in an entertaining and attractive style, and his success none who have read the book can doubt. Indeed, so cleverly has he employed the concrete method of fiction in bringing out the picturesque aspect of history and the delineations of social life that his work can scarcely fail to be appreciated by students, even those who look upon history as a collection of dry facts that must be learned.

Professor Allen, taking as he did a composite view of Roman society, has presented the political, economic, literary, and religious elements in the life of the Roman people in their relations with each other; maintaining, not without ground, that they are incapable of intelligent comprehension if presented in isolation. It is also worthy of note that, in connection with these fundamental observations, the land question and the history of literature and religion are most carefully and intelligently treated. And, to awaken a greater interest in the life of the times, frequent references are made to carefully selected historical nov-

els, and to popular works, for collateral reading. The book throughout is excellently arranged for easy reference, supplemented by an exhaustive index. Teachers, also, will notice that the more important dates are incorporated in the text, while a free use of marginal dates serves to give more detailed guidance to the reader. Excellent judgment and good taste are displayed in the selection of maps and illustrations. The colored maps are reproductions of the charts accompanying Professor Herman's well-known Historical Geography of Europe, while the cuts are principally from Prang's Illustrations of the History of Art, and Jaeger's Weltgeschichte.

The International Medical Annual. 1890. Edited by P. W. Williams, M. D. 8°, cloth, 600 pp. E. B. Treat, New York. (Price \$2.75.)

The eighth yearly issue of this handy reference manual is at hand. But little change has been made this year in the general scope and aims of the Medical Annual, the editor being content to maintain the high standard of former years. It does, however, present two improvements which ought to be acceptable to all; the size of the page has been enlarged, and the binding made more firm and substantial.

In the preparation of this volume Dr. Williams has had the assistance of thirty-six European and American collaborators, all of whom are well-known specialists in their several departments; and the result of their combined labor is highly creditable, even to so distinguished a staff of editors.

In the Therapeutical Section, there has been introduced, in addition to the Dictionary of New Remedies, a contribution on Baths and their Therapeutic uses; or, more correctly speaking, the therapeutics of heat as exemplified by baths and bathing; Electro-Therapeutics has also been brought fully up to date in this part of the issue. Mindful of the fact that Sanitation is a science that is daily pressing to the front, the editors have very properly introduced important papers upon Sanitary Science in city and country. The Alphabetical Index of New Remedies, and the Dictionary of New Treatment are both exhaustive, and add much to its value as a reference volume. The important and interesting papers upon Thermo-Therapeutics, and the Medical Examiner in Life Insurance are features of special interest. We can but commend the judicious use of illustrations, which are introduced only where they seemed useful to the text. It is truly a helpful volume, a *résumé* of the year's progress in medicine, keeping the busy physician practitioner abreast of the times with reference to the medical literature of the world.

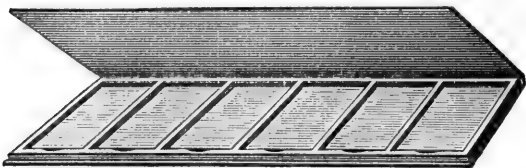
The Evolution of a Life. By Henry Truro Bray, LL.D. 12°, cloth, 436 pp. Holt Publishing Co., Chicago. (Price, \$2.00.)

The chief character in this work is the author, who, having served for many years as a priest in the Protestant Episcopal Church, finally cast aside his surplice for the garments of what seemed to him a higher and diviner faith. The author does not hesitate to make us acquainted with his somewhat strange descent, and the long period of his education. His domestic relations and home life are also brought before our view, much of the book being in the form of conversation between the author and his wife. The work purports to be a revelation of minis-

terial life, in which we are in a measure admitted behind the scenes; but some may feel inclined to doubt the reality of the amazing sights we are made to see. However this may be, the book is written in an entertaining style; and the author displays no little ability in picturing his transitions from the heights of bliss to the depths of woe. Considerable theological discussion is interjected into the volume the force of which is to justify his abandonment of the fundamentals of Christianity. Any one who wants to reopen these questions will be much interested in that part of the volume, and should also read "God and Man," by the same author.

—O—

Griffith's Slide Pocket-Book.—In the accompanying figure is shown a very simple and neat contrivance for carrying slides from place to place. It is designed by Mr. E. H. Griffith, of Fairport, N. Y., who is well known to the microscopic world by his excellent devices and microscopic improvements. This cabinet is fitted up to hold six objects, each of which is separated from the other by a wooden partition. When closed the box resembles a very neat black cloth-covered pocket-book, hence the name.



SUBSCRIBERS' NOTICES.

[These notices will be given six insertions in this column at 25 cents per line or fraction thereof.]

FOR EXCHANGE.—Slides of selected diatoms.

D. B. WARD, Poughkeepsie, N. Y.

WANTED.—Unmounted microscopical material, also micrographic dictionary. Will exchange or buy.

CHARLES VON EIFF, 124 Clinton Place, New York City.

WANTED.—A clean copy of Rev. William Smith's British Diatoms, and Schmidt's Atlas of the Diatomaceæ.

JAMES B. SHEARER, Bay City, Mich.

OFFERED.—Diatomaceous Earth from Utah (Desert) for Histological Mounts.

PROF. ORSON HOWARD, Salt Lake City, Utah.

CORRESPONDENCE invited with a view to the exchange of either mounted or unmounted Oribatida (British) for American species.

E. BOSTOCK, Stone, Staffordshire.

WANTED.—Any works on Microscopy not already in my Library.

H. M. WHELPLEY, F. R. M. S., St. Louis, Mo.

Labels in exchange for slides.

EUGENE PINCKNEY, Dixon, Ill.

First-class Histological Slides for other good mounts; Histological and Pathological material cut on shares.

S. G. SHANKS, M. D., 547 Clinton Ave., Albany, N. Y.

OFFERED.—Griffith & Henfry Micrographic Dictionary to be sold; also Hoggs Microscope.

J. P. WINTINGHAM, 36 Pine St., N. Y.

WANTED.—A clean copy of Wolle's Fresh-Water Algæ of the United States (2 vols.); also good second-hand Grunow Camera-Lucida, and a self-centering Turn-table.

JOS. P. THOMPSON, P. O. Box 1383, Portland, Me.

FOR SALE CHEAP.—New Gundlach $\frac{1}{8}$ homogeneous-immersion objective, for $\frac{1}{20}$ glycerine or water objective.

J. M. ADAMS, Watertown, N. Y.

FOR SALE.—A Bausch & Lomb Stand, A. & C. eyepieces, 1 in. and $\frac{1}{2}$ in. objectives.

BOX 1, Evanston, Ill.

FOR EXCHANGE.—Cabinets of lower silurian fossils for microscopical apparatus or objects. Correspondence invited.

E. L. SHERWOOD, Houston, Miss.

OFFERED.—\$400 in prizes. For details see article in January number of this journal for 1890.

C. A. STEPHENS, Norway Lake, Me.



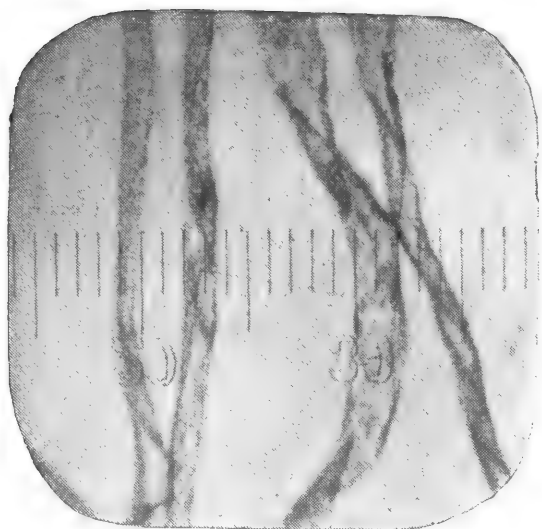


FIG. 1.



FIG. 2.



FIG. 3.



FIG. 4.

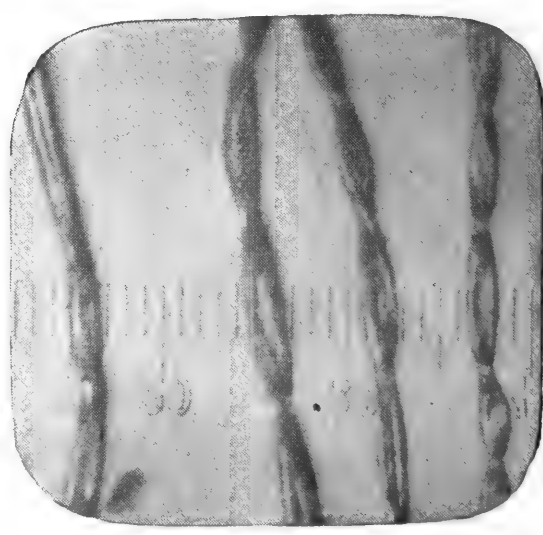


FIG. 5.

THE AMERICAN MONTHLY MICROSCOPICAL JOURNAL.

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No. 5.

All communications for this Journal, whether relating to business or to editorial matters, and all books, pamphlets, exchanges, etc., should be addressed to American Monthly Microscopical Journal, Box 630, Washington, D. C.

European subscriptions may be sent directly to the above address accompanied by International Postal Order for \$1.15 per annum, or they may be sent to Messrs. Trübner & Co., 57 Ludgate Hill, London, or to Mr. W. P. Collins, 157 Great Portland street, London, accompanied by the yearly price of five shillings.

A Microscopic Study of the Cotton Plant.

By P. H. MELL,

AUBURN, ALA.

I. SPECIES AND VARIETIES.—There are several species of the cotton known to botanists, but only three are of special commercial importance. These three are called :

Gossypium Bahma, or Egyptian cotton.

Gossypium barbadense, or *G. nigrum*, or Sea Island cotton, or long staple or black-seed cotton.

Gossypium herbaceum, or *G. album*, or short staple, or upland or green-seed cotton.

Monsieur Rohn also divides the species into—

1. Those with seeds rough and black.
2. Those with seeds brownish black and veined.
3. Those with seeds sprinkled with short hairs.
4. Those with seeds completely covered with close down.

The three species above mentioned have been multiplied into twenty or thirty so-called *varieties*.

II. WHAT IS COTTON FIBRE?—When cotton is first taken from the boll it consists of seed with the germ surrounded by its food, a coating or covering called by oil manufacturers the “hull,” and by botanists, outer and inner seed-coats, and the outside envelope of elongated threads or tubes that are attached to the outer seed-coat. These threads are, in fact, simply elongated cells of this coat. These cells cover thickly the whole surface of the seed, and in ginning it is necessary to tear them off by rupture at the portion near the seed-coat. Seeds are cleanly

EXPLANATION OF PLATE.

FIG. 1.—Common variety of cotton—unfertilized.

FIG. 2.—Same—blighted.

FIG. 3.—Cross-sections of (1) Common variety,
(2) Rameses, (3) Cherry's cluster,
(4) Forked-leaf or Okra, (5) Peerless.

FIG. 4.—Peerless.

FIG. 5.—Truitt (strong, well-twisted, many-seeded).

ginned in proportion to the distance from the surface reached by the cutting edges of the teeth of the ginning saws. The thread or fibre in its young state is cylindrical, but upon maturing and becoming dry it collapses and assumes a more or less flat, ribbon-like, twisted form. The degree of twist given the fibre, its regularity in diameter and length determine the value of the cotton in the markets of New York and Liverpool.

III. VARIETIES TESTED.—I obtained a number of samples of cotton, representing eighteen varieties, two selected specimens from Savannah, Ga., of the Sea Island cotton and a sample of the "Bailey" fibre from North Carolina. Careful studies have been made of these specimens under high powers of the microscope, and a number of interesting results were obtained. The following are some of the questions considered:

1. How many real varieties of cotton exist?
2. In forcing the plant under high cultivation is the fibre improved, or is simply the "weed" enlarged to the detriment of the staple? Is it not often the case that the fruit of the cotton plant is damaged by too rapid maturing, just as the fruit of the peach is known to be immature at the centre in some early forced varieties?

Many experiments were made on each of the samples to determine the diameter and regularity of fibre, the average length of the strands, the character of twist and the internal structure. Also several strands were selected at random from the bolls and the strain necessary to break them carefully determined by fastening one end of the fibre and weighting down the other until rupture was produced.

Sample number 1 was a poor grade of cotton that was obtained from stalks about ten to twelve inches high, growing on sandy soil unfertilized. Four tests of the strength were made with two strands in each test with the following results: 1st, Broke under a strain of 9.498 grammes; 2d, 19.057 grammes; 3d, 21.404 grammes; 4th, 11.635 grammes. Average for two strands 15.398 grammes (1 gramme is equivalent to 15.43 grains). Length of fibre 1st test, 22.4 millimeters (1 millimeter is equivalent to 0.039 of an inch); 2d test, 24 millimeters; 3d test, 23.2 millimeters; 4th test, 24.8 millimeters. Average length of fibre, 23.6 millimeters. The diameter ranged from 0.009 millimeters to 0.016 millimeters. These results indicate a lack of uniformity. When the fibres were placed under the microscope it was noticed that some were immature, some were only slightly twisted, while others, though well twisted, were small and weak.

Number 2 was obtained from the same field but from a plat that had been fertilized with floats. The stalk was small and badly blighted, but the fibre was about the same grade with number 1. The grade of both plants is so low in the scale, the injury to the fibre may be due largely to immature growth in the plant before the blight obtained headway. However, this is difficult to determine with these samples, as they were obtained so late in the season.

Number 3 was also obtained from the same field and the same plat from which No. 1 was drawn. The plant was not blighted, but the stalk was small. In the first test upon the strength of two strands the fibre broke under a load of 27.475 grammes; 2d, 33.915 grammes; 3d, 29.000 grammes; 4th, 45.176 grammes. Average for two strands,

33.891 grammes. Length of fibre 1st test, 25.6 millimeters; 2d test, 20 millimeters; 3d test, 23.2 millimeters; 4th test, 22.4 millimeters. Average length, 22.8 millimeters. Diameter of fibre, 0.016 millimeters. This is an improvement over the two preceding. The twist of the fibre is an average, but there was a good deal of waste in the boll.

Number 4 was obtained from the same plat that No. 2 came from, but was not blighted. Rupture: 29.151, 23.652, 21.061, 26.719 grammes. Average for two stands, 25.145 grammes. Length of fibre, 17.6, 21.6, 21.6, 21.6 millimeters; average length, 20.6 millimeters; diameter, 0.016 millimeters. The twist was medium. The resistance to rupture was more uniform than the preceding, and the staple was a better grade.

Number 5 was another specimen of blighted cotton from the same field in the plat fertilized with floats and cottonseed meal. The fibre was quite imperfect in development, and the twist was inferior. Resistance to rupture: 13.990, 5.620, 11.237, 13.000 grammes. Average

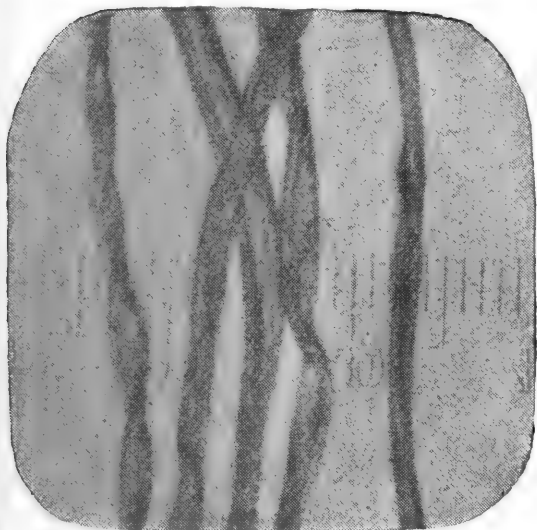


FIG. 6.—Okra—or fork-leaved (longest fibre).

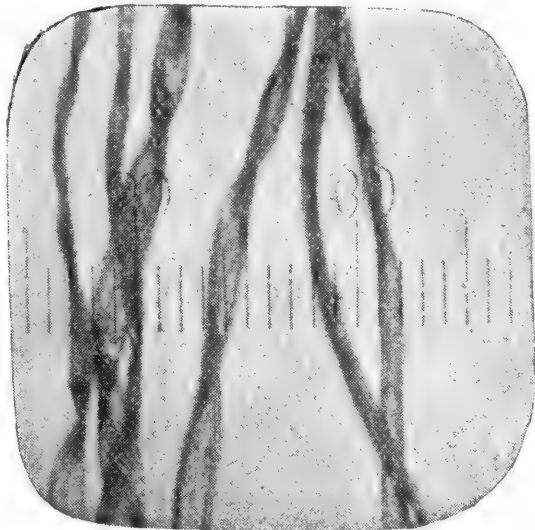


FIG. 7.—Allen's long staple.

resistance, 10.962 grammes. Average length of fibre, 20.2 millimeters; diameter, 0.024 millimeters.

Number 6 represents the variety Peerless. The stalk was large, well developed, and loaded with fruit. The field in which the plant grew was fertilized with compost, 200 pounds cottonseed meal, and 200 pounds acid phosphate, 1,000 pounds to the acre. The diameter of fibre was 0.016 to 0.024 millimeters, the last measure predominating. The twist was about an average and the length ranged from 18 millimeters to 20.8 millimeters. Average 18.5 millimeters. The resistance to rupture: 23.142, 20.552, 28.044, 11.623 grammes. Average 20.840 grammes. This is a good grade of cotton, with even texture and uniform diameter.

Number 7, or Welborn's Pet, was fertilized in the same manner that was used with No. 6. The plant was large, well fruited, and apparently healthy. Diameter of fibre, 0.016 to 0.024 millimeters. Length: 21.6, 23.2, 21.2, 22.4 millimeters. Average 22.1 millimeters. Resistance

to rupture: 12.258, 15.850, 15.902, 11.430 grammes; average, 13.860 grammes. Twist of fibre average. The grade of this cotton is below that of the Peerless, because the fibres were irregular in diameter, yielding weak places in the strands.

Number 8, or Truitt, from the same field with the last and fertilized in the same manner. The plant was well grown and well fruited. Diameter of fibre, 0.016 to 0.024 millimeters. Twist excellent. Length, 22.4, 22, 21.4, 21.6; average 21.8 millimeters. Resistance to rupture: 35.437, 28.472, 36.856, 20.525 grammes; average, 30.322 grammes. The strength of the fibre is high, and the grade of the cotton excellent.

Number 9, Rameses, fertilized in the same manner as No. 6. Plant was well grown and heavily fruited. Diameter of fibre, 0.019 to 0.024 millimeters. Length, 20.8, 17.6, 21, 20.8 millimeters; average, 20.1 millimeters. Twist excellent. Resistance to rupture: 25.566, 28.702, 29.212, 25.558 grammes; average, 26.758 grammes. The staple was of uniform strength and uniform diameter.



FIG. 8.—Ellsworth.

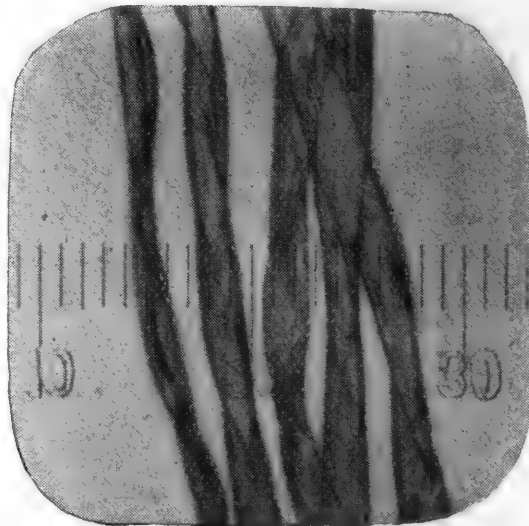


FIG. 9.—"Brandon."

Number 10, Cherry's Cluster, same fertilization. Plant in good condition and well fruited. Diameter of fibre, 0.019 to 0.027 millimeters. Twist excellent. Length, 23.2, 22.4, 23.2, 20.8 millimeters; average, 22.4 millimeters. Resistance to rupture: 35.216, 18.695, 38.690, 25.310 grammes; average, 29.477 grammes.

Number 11, Okra or Forked Leaf, same fertilization. Plant in good condition and well fruited. Diameter of fibre, 0.016 to 0.027 millimeters. The last measurement predominated. The twist was poor. Length, 31.2, 33.6, 28.8, 28 millimeters; average, 30.4 millimeters. Resistance to rupture: 17.933, 18.470, 10.471, 10.088 grammes; average, 14.240 grammes. The strength of this variety is not as great as the last by one-half. This was due to the fact that the twist was poor and the diameter was not the same throughout the length of the fibre, and the weak points quickly yielded to the strain applied.

Number 12, Hawkins improved, fertilized with cottonseed meal and acid phosphate, 200 pounds to the acre. Diameter of fibre, 0.008 to

0.016 millimeters. Twist poor. Length, 19.2, 16, 18.4, 16.8 millimeters; average, 17.6 millimeters. Resistance to rupture: 12.446, 2.991, 10.710, 8.333 grammes; average, 8.620 grammes. These results indicate an inferior condition of the cotton. The fibres were irregular in diameter with weak points, and a number of strands on the seeds were immature in development.

Number 13, Allen's long staple, fertilized in the same way that was used with Hawkins'. Diameter of fibre, 0.016 to 0.024 grammes. Twist inferior. Length, 26.4, 25.6, 26.4, 27.2 millimeters; average, 26.4 millimeters. Resistance to rupture: 17.353, 14.539, 15.516, 23.975 grammes; average, 17.845 grammes. The fibre of this variety was more mature and even in diameter, although the twist was inferior, hence it withstood the strain quite well; but the grade can be considerably improved.

Number 14, Jones' improved, fertilized like Hawkins'. Diameter



FIG. 10.—Sea Island—or Florida No. 1.

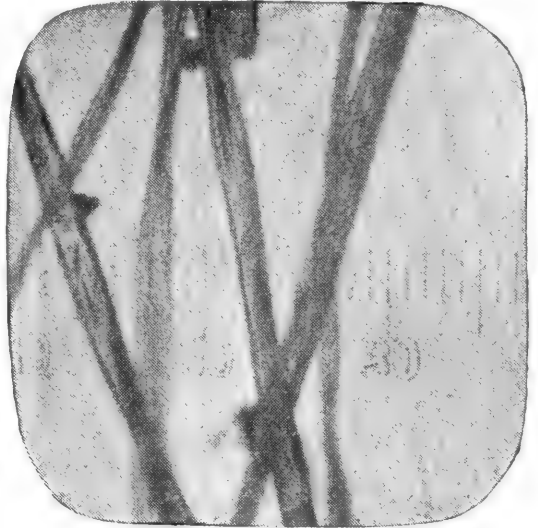


FIG. 11.—Sea Island—No. 2 (shortest fibre.)

of fibre, 0.016 to 0.024 millimeters. Twist medium. Length: 22.4, 22.4, 23.2, 23.2 millimeters; average, 22.8 millimeters. Resistance to rupture: 23.083, 15.323, 25.448, 20.900 grammes; average, 23.338 grammes. The grade of this cotton is an improvement over the last.

Number 15, Zellner, fertilized the same way. Diameter of fibre, 0.016 to 0.020 millimeters. Twist good. Length: 21.6, 21.6, 23.2, 23.2; average, 22.4 millimeters. Resistance to rupture: 20.130, 28.106, 26.345, 15.644 grammes; average, 22.556 grammes. This is also a good grade of cotton.

Number 16, Barnett's short staple, fertilized in the same way. Diameter of fibre, 0.016 to 0.028 millimeters. Twist poor. Length: 22.8, 24.2, 23.2, 24.8 millimeters; average, 24.8 millimeters. Resistance to rupture: 10.960, 10.370, 12.050, 8.363 grammes; average, 10.436 grammes. The fibre was so weak it was difficult to handle without breaking. The strands were immature in development.

Number 17, King's improved, fertilized in the same way. Diameter of fibre, 0.012 to 0.016 millimeters. Twist good. Length: 17.6, 20,

15.6, 20 millimeters; average, 18.3 millimeters. Resistance to rupture: 15.720, 12.996, 16.490, 18.100 grammes; average, 15.826 grammes. Although the average resistance is low, still the strands were of uniform strength, and with higher fertilization the plant may be made to produce excellent cotton.

Number 18, Ellsworth, fertilized in the same way. Diameter of fibre, 0.012 to 0.024 millimeters. Twist good. Length, 21.6, 21.6, 21.2, 20 millimeters; average, 21.1 millimeters. Resistance to rupture: 20.330, 22.050, 20.685, 20.838 grammes; average, 20.976 grammes.

Number 19, Georgia, ordinary upland. Sent to me by W. W. Gordon & Co., commission merchants of Savannah, Ga. Character of fertilizer not known. The fibre was received in a ginned condition, and the number of seed to boll and weight of staple could not be determined. Diameter of fibre, 0.012 to 0.016 millimeters. Twist medium. Length of fibre could not be accurately determined, because the cotton was sent to me ginned. Resistance to rupture: 19.038, 17.597, 21.965, 13.650 grammes; average, 18.083 grammes.

Number 20, Peterkin. Obtained from farm of Experiment Station. Character of fertilization—1,000 lbs. compost per acre, in the drill. Diameter of fibre, 0.008 to 0.016 millimeters. Twist medium. Length, 22, 25.2, 23.2, 22.4 millimeters; average, 23.2 millimeters. Resistance to rupture: 20.757, 14.438, 11.490, 20.649 grammes; average, 16.834 grammes.

Number 21, Southern hope. Fertilized like Peterkin. Diameter of fibre, 0.016 to 0.020 millimeters. Twist good. Length, 27.2, 23.2, 23.2, 24 millimeters; average, 24.4 millimeters. Resistance to rupture: 13.363, 21.453, 29.903, 22.928 grammes; average, 21.912.

Number 22, Bailey. Obtained from the Bailey Cotton Co., of Raleigh, N. C. The sample was ginned, and hence, lengths of strand, number of seed to boll, and weight of fibre were not determined. Diameter of fibre, 0.019 millimeters. Twist poor. Resistance to rupture: 18.683, 15.413, 12.066, 18.687 grammes; average, 16.212.

Number 23, sample obtained from Mr. W. N. Brandon, of Coffee Springs, Alabama. The name of the variety was not furnished me, but the plants were thrifty and healthy, and averaged three feet in height; well fruited. The fertilizer used was 1,200 pounds to acre of stable manure, with pine straw and leaves, and 125 lbs. of guano to acre in the furrows before bedding, and 75 pounds to acre about the last of May. Diameter of fibre, 0.024 millimeters. Twist medium. Length of strands, 21.6, 16.8, 19.2, 20.8 millimeters; average, 19.6 millimeters. Resistance to rupture: 14.303, 24.556, 25.173, 17.500 grammes; average, 20.383 grammes.

Number 24. Sea Island No. 1, obtained from P. D. Duffin, commission merchant, Savannah, Georgia. Diameter of fibre, 0.016 millimeters. Twist average, with weak places. Length averages 37 millimeters, but this is only approximate, as the sample sent me was ginned. Resistance to rupture: 16.462, 23.726, 16.968, 9.606 grammes; average, 18.602 grammes.

Number 25. Sea Island No. 2, obtained from W. W. Gordon & Co., commission merchants of Savannah, Georgia. Mr. Gordon states that this sample is not genuine Sea Island, but that its quality has been

somewhat changed by growing the plant in the interior of Florida. The cotton was ginned and the length, 48 millimeters, can only be approximate. The fibre was slightly stained with adhering particles of dust. Diameter, 0.016 to 0.024 millimeters. Resistance to rupture: 17.447, 12.156, 14.356, 7.506 grammes; average, 15.578 grammes.

It seems evident from the foregoing, that it is not always the large plant that produces the best condition of the fibre. Experiment seems to determine that the most excellent condition of the fibre is produced only on those plants that are healthy in all their functions, neither too rapid nor slow in their development, and that are given all the advantages of judicious cultivation with the proper fertilization and under the most favorable conditions of the atmosphere. In improving the grade of cotton the following must also be carefully noted. The plant must be forced to produce fibre, that is—

1. Long, and as nearly as possible, uniform in length.
2. Of uniform diameter throughout.
3. Flat and ribbon-like, and well twisted.

The cells must not collapse until well matured, so that the collapsing and twisting will occur with equal intensity throughout the entire length of the tube.

I will state as a proposition: No plant has a right to a new name unless it is able to produce fibre closely approaching the above conditions. The cultivation of cotton is chiefly for the staple it produces, and every effort should be made to improve its quality.

THE IMPROVEMENT OF THE SEED.—The seed is the beginning of the new plant, and contains within itself all the future possibilities of the full developed plant it will produce. There is an old expression that what the child is, so will be the man. This is true of the vegetable as of the animal kingdom. Imperfect seed must produce imperfect plants. The intelligent farmer has often noticed in his fields of cotton, some plants much larger than others, containing a larger number of well-formed bolls, and with fibre whiter, more silky, and better in quality than on any other plant in the field. If he would select from this plant the bolls that are the largest, the finest, and most perfectly matured, and after ginning the cotton carefully select the seed, rejecting all that are blasted or imperfectly shaped, and then carefully protect them to prevent fermentation or becoming in any manner damaged until the next planting season, the first important step would be taken. There is no chance in this matter, if we follow closely the laws by which nature performs her perfect work. The cotton seeds that have thus been carefully collected from the first plant must be placed in the best prepared soil, under the best conditions and well cultivated. No cotton of an inferior grade must be planted in the immediate neighborhood. In fact, it does not pay to cultivate inferior cotton, and it is best to send all such seeds to the oil mills. When blooms of low grade cotton open, insects and winds will soon transport the pollen from them to the pistils of the selected variety and the germs will become depreciated by such inferior fertilization. There are a number of insects that visit the flowers of the cotton plant for the nectar they contain; and in the effort to reach the base of the flower where the nectar is found, their bodies become covered with pollen that is transferred to the stigma where they come in contact with pistils of other flowers. It

is readily seen, therefore, that if plants of an inferior grade are growing and blooming in the immediate neighborhood of the selected varieties, the insects will soon convey the pollen from the inferior to the superior plant and the seed that will be produced will contain a germ with qualities of the inferior plant. This work of the insects might explain to some extent why it is that improved seeds in a few years degenerate so badly. If the selection of the seed is repeated from year to year, and no inferior cotton planted near enough to vitiate with its pollen by means of insects or wind, and if seasons are favorable, there seems to be no reason why practically perfect plants may not be produced.

THE CHARACTER OF THE SOIL.—It goes without saying that a soil in the first place must contain those mineral elements of plant food in a most available form that the cotton necessarily requires for its full development and maturity. This information is obtained by a chemical analysis of the plant with all its products, and a careful examination of the soil by means of tests made with the growing plant and fertilizers now so well understood by most intelligent farmers.

Besides the ingredients comprising the soil it should have certain physical properties, without which it would be wholly inadequate for the purposes of producing well-matured plants. It should have the power to absorb and retain moisture, so that in times of drought, in August and September, when seed and fibre are to be formed, and when diminished leaf activity is desirable, the soil should have sufficient moisture in composition to enable the roots to draw it up into the plant at a time when most needed. The soil must be so friable that when rains fall the moisture will sink and not stagnate about the roots.

THE CONDITION OF THE WEATHER.—This factor we cannot control, but we can at least make the most of what has been given us. This southern country is peculiarly adapted to the cultivation of cotton because of its sunny climate. This plant requires a warm atmosphere for its full development, and hence it produces fibre in diminished quantity and perfection in more northern than southern latitudes. The high heat of a midday summer's sun seems not to injure cotton as it does corn and other like plants. Cotton is decidedly a sun plant.

The proper supply of moisture is of equal importance with temperature. The plant will stand great heat, provided it is not growing in a very dry atmosphere, and is in a soil that can retain moisture. According to Mallet moisture may be supplied to the cotton plant in several ways:

1. "The atmosphere may contain a greater or less amount of water in the state of vapor up to the so-called point of saturation.

2. "The atmosphere may be supersaturated, or, in other words, rain may occur.

3. "The soil may contain greater or less amount of water intimately united with it, whether by adhesion or in chemical combination, such water as is rapidly absorbed from the air by dried soil, and can only be expelled by high temperature. This water does not render the soil moist to the touch.

4. "The soil may be supersaturated and rendered moist or wet. The larger amount of water that is taken by the cotton plant in the first (atmospheric vapor) and third ways (soil water absorbed from the air under ordinary conditions), and the smaller amount that it receives in

the second (rain) and fourth ways (saturated soil), the more favorable will be the result. In water-soaked soil cotton will not thrive. It scalds and looks sickly. In the early stages of its growth the plant receives with advantage a moderate supply of moisture in the form of rain (water in the second condition), but even then *heavy rains are injurious*, and later in the season *they are absolutely destructive*; the bolls do not open, but fall or rot on the branches; a surface growth of weeds and grass accumulates so rapidly as to choke the crop; the boll worm and other insects appear in great numbers, and the crop is considerably cut off. Dry years are emphatically those of the largest and best crops."

In a dry season when the supply of moisture has been moderate, and the plant is young and vigorous, the tap root penetrates to great depth where the supply of soil water is not so much under the control of periodical or ordinary atmospheric changes. The plant is, therefore, enabled to withstand a long drought; and, if the moisture from the atmosphere has been given in small quantities all along its growth, the fibre becomes long, even, and soft, the bolls open wide, and the fleecy staple hangs in long, silken folds from them. Much rain and rapid growth of grass in May and June prevent the full development of the tap root, and encourage a great multiplication of surface roots; and, as soon as the hot, dry atmosphere of July and August sweep across the fields, the plants wither and shed because there is little tap root to bring up moisture from below the surface of the soil.

From the examinations it may be concluded that:

The strongest cotton fibre was produced by Truitt.

The largest fibre was produced by Barnett.

The smallest fibre was produced by No. 1, Hawkins' Improved, and Peterkin.

The longest fibre was produced by Okra Leaf.

The shortest fibre was produced by No. 2.

The best twisted fibres were produced by Truitt, Rameses, and Cherry's Cluster.

The largest percentage of fibre per boll was produced by Welborn's Pet, Okra Leaf, Peterkin, Hawkins' Improved, King's Improved, and in the order named.

The largest percentage of seed per boll was produced by Zellner, Rameses, Southern Hope, Truitt, and in order named.

The best grade of cotton, taking all things into consideration, is Cherry's Cluster. The second best grade is Truitt.

THE CUTS.—The illustrations representing the longitudinal views of the cotton are given in order to show the *twist of the fibre*, and to indicate the relative sizes of the different strands. The measurements shown in the cuts are photographs made with Zeiss' ocular micrometer. These photographs were made with Bausch & Lomb's professional photo-micro camera, fitted with Zeiss' objective (0.30 aperture and 16 mm. focus) and compensated ocular 6, with micrometer.

The cross sections shown were magnified with Zeiss' microscope containing objectives 16, and ocular 6. They were drawn by the aid of Zeiss' camera lucida (after Abbe). These sections are given to show what is known to be a well-developed fibre, and one that is imperfectly formed. The well-developed strand is shown by Okra and Cherry's Cluster, and imperfect fibres are noticed in two figures.

The variety Truitt is decidedly the best cotton, because the strands are not only of a uniform size, but they are also remarkably well twisted. Allen's Long Staple is not so satisfactory. The twist is not as good, and the strands are irregular in size—some being quite small and weak. The two cuts representing Sea Island varieties show inferior grades of cotton, weak and a decided lack of proper twist.

Each division on the scales represented in the cuts is equivalent to about $\frac{1}{1600}$ of an inch.

Cheap Boxes for Slides.

By HENRY SHIMER,

MT. CARROLL, ILL.

W. P. Hamilton's slide box described in the January number reminds me of a very nice arrangement. A box ready-made is more apt to be used than one made on purpose. For instance, the ordinary cigar box costing nothing. The flat ones are most suitable. They vary in size somewhat, but the ordinary one is about $4\frac{1}{2}$ by $8\frac{1}{2}$ by 2 inches inside. It can be filled with card-board trays like Hamilton's, or with wooden ones made of cigar boxes. The bottoms and lids will make bottoms for the trays, and the sides and ends sawed into narrow strips $\frac{1}{8}$ or $\frac{1}{4}$ inch wide and tacked on with brads, will make the margins. Each box will hold five trays. The bottom may be used instead of a tray by tacking a marginal strip in each end. Each of such boxes will store 70 short German slides, which by all odds are preferable, or it will hold 45 to 50 of the 3-inch slides. If we make the trays of cardboard, as per Hamilton, and a 3-inch holds 24, 2-inch holds 16 trays. Then 14 short slides to a tray gives room for 224 slides; 9 3-inch sheets to a tray gives 144 slides, or 7 to a tray will give 112 slides, and allow about $\frac{3}{4}$ -inch margin on the sides and a little less on the ends. Such boxes are neat, cheap, and convenient. The slides lay flat. These boxes can be numbered or otherwise labelled on the ends and stowed in book-cases.

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Bolting Gauze.—Mr. Charles M. Vorce, of Cleveland, Ohio, writes that he has “done no microscopical work lately that has any novelty in it, unless it may be the measurement of an assortment of bolting gauze and other goods used for sieves, to ascertain the average and maximum sizes of the particles which pass through the same, and the relation of such size to the rating of the goods, which is always by the number of meshes to the inch or centimeter. Bolting gauze of ‘200 meshes to the inch’ will not pass particles of approximately globular form larger than about $\frac{1}{400}$ inch, and the *average* size of the particles passed will be considerably less, about $\frac{1}{450}$.”

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CORRECTION.—On p. 60 for *Puccinia anemories* read *Puccinia anemones*; for animal read annual.

Annual Address before the Washington Microscopical Society delivered at its Soiree for 1890.

By E. A. BALLOCH, M. D.,

WASHINGTON, D. C.

The Microscopical Society welcomes you to its Sixth Annual Soirée. That these meetings are occasions of interest and profit to the general public is shown by the large and increasing attendance upon them. We are glad to see you once a year, but we should be more glad to know that your interest in the microscope was perennial and not annual. The amount of time and trouble necessary to the successful conduct of one of these soirées can only be appreciated by those upon whom the labor devolves. But we are not wholly free from selfish motives in this matter. We hope, by means of these meetings, to add recruits to the increasing army of users of the microscope, and to familiarize you with this most fascinating of instruments.

Many, doubtless the most, of you view the microscope with a feeling somewhat akin to awe. It appears to you a mysterious instrument, capable of revealing wondrous things and not to be handled by the uninitiated.

The glittering array of polished brass and shining lenses makes you feel that years of study and preparation must be necessary to the successful use of this instrument.

Nothing could be further from the truth, and it is my purpose to-night, in a brief way, to divest your minds of some popular errors with regard to the microscope, and to indicate to you what may be done with a comparatively inexpensive instrument, and a limited number of accessories.

No man has done more for the art of microscopy than Leeuwenhoek, a Dutch scientist, who lived and worked in the latter part of the seventeenth century. All his observations were made with simple globules of glass, ground and polished by himself, and set in brass frames. Yet, with this primitive apparatus, he made observations which are marvels of accuracy, and many of his descriptions are as true to-day as when he made them, two hundred years ago. But, you will doubtless say, I have neither the time, patience, nor ability to make microscopes like Leeuwenhoek, nor can I, in view of the limited use I should make of it, afford to purchase a costly instrument like those I see here. The answer to these objections is easy: You need do neither.

All manufacturers of microscopes make instruments, moderate in price, with which you may do work from which you may derive an abundance of profit and entertainment.

But, I hear someone say, after all it will be but a mere toy and of no lasting benefit. This is a stock criticism on the use of the microscope, and, like many of its class, based upon no solid foundation. I will cite you a few instances out of many, in which the microscope may be useful in every-day life, and let them answer this objection.

We will assume that you are about to order a suit of clothes, or your wife a dress from a piece of goods which is represented to you as "strictly all wool." You take a sample home with you and place a few fibres under the microscope. If, perchance, you see two fibres of cotton to one of wool you may be reasonably sure that you are the vic-

tim of misrepresentation, to say the least. It needs no special training to enable one to distinguish between fibres of cotton, wool, linen, and silk. It can be done at a glance as you will be able to see in one of the exhibits here to-night.

Again, to turn from the outer to the inner man, we will say that you are fond of the "cup that cheers," and that you will have no tea but the best. You pay a fancy price for tea which you are assured is the genuine article. You steep a few of the leaves and examine their serrations under the microscope. A little practice will enable you to distinguish the tea-leaf from those of the camellia, black currant, or willow, which are the more common adulterants. A little further manipulation will enable you detect the "stone cells," characteristic also of the tea-leaf. One of our honored members, Dr. Taylor, has lately been giving a great deal of attention to this subject, and has examined it with his accustomed thoroughness.

In his exhibit to-night you may see under the microscope genuine tea and the more common adulterants. With a little experience you may apply proper tests to mustard, coffee, butter, and many other articles of daily consumption. I will not take up your time to enumerate other instances, as it seems to me that these two are sufficient to meet the objection that the microscope is not a practical instrument.

Turning from this side of the question, let us look for a moment at the microscope as a source of amusement and relaxation.

The tired business man or weary clerk, after a hard day's work, takes down his microscope and in a moment he is in another world. The cares of business are forgotten and the exhausted brain is rested and refreshed. A drop of stagnant water will afford you employment for all the time you have to spare. If any one of you will try to identify and study each and every microscopic plant and animal he may see in a few drops of ditch water, you will find your labors stretch over months instead of days.

And right here let me disabuse your minds of the current impression that the purest water will, when viewed under the microscope, be found swarming with animal life and peopled with strange and hideous monsters. As a matter of fact, pure water is absolutely free from animal or vegetable matter. Even the ubiquitous microbe and bacterium are wanting. But there is enough microscopic richness in a sample of stagnant pond water to satisfy the most ardent investigator. Then there are the common house-fly, the insects and butterflies which we see by day, and the busy mosquito which we hear at night, any one of which will afford material for many hours of work and pleasure. There are, in fact, thousands of objects literally within reach of our hands.

It is possible that, in the course of your general and purposeless use of the microscope, you may gradually be led into some special line of study. Should this be the case you may be able to make original and valuable observations and contribute your mite toward increasing the sum of human knowledge. I speak within the truth when I say that in no branch of science has the field been anything like thoroughly cultivated, and there is hardly one of them in which the microscope is not, in some way, useful. You will see, therefore, that there are abundant opportunities in many lines of work for the conscientious investigator.

Do not, however, make your field too narrow. You will all recol-

lect the microscopist of one idea so accurately portrayed by Holmes as the Scarabee, in the "Poet at the Breakfast Table." His one object in life is to prove that a parasite of the bee, the *pediculus melittæ* is the larva of *melæ*. Let me quote the passage in which he sums up his ambition: "'The question is whether he is the larva of *melæ*,' the Scarabee said. * * * 'If I live a few years longer it shall be settled, sir; and if my epitaph can say honestly that I settled it, I shall be willing to trust my posthumous fame to that achievement.'"

But I know that your main interest is in the display below stairs, and I will not detain you longer. My aim has been to endeavor to show you—

First. That the microscope is essentially a practical instrument, more practical in fact than any other piece of optical apparatus.

Second. That very expensive instruments and accessories are not absolutely necessary.

Third. That as a source of entertainment and pleasure this instrument has no rival, and—

Fourth. That there are abundant opportunities for the worker in all departments of science.

If these brief remarks shall be the means of turning the attention of any one here to-night toward the instrument, the use of which is the common bond of union of this Society, I shall esteem myself, indeed, fortunate.

Japanese Lacquer.*

By ROMYN HITCHCOCK,

WASHINGTON, D. C.

Japanese lacquer is the product of a tree (*Rhus vernicifera*) which grows throughout the main island of Japan. It attains a large size and will live for forty years, but only comparatively young trees are valued for the production of lacquer. Having yielded for several years, they are cut down, the lacquer extracted from their branches, and young trees take their places. The best lacquer comes from Yoshino, in Yamato. The lacquer exudes from horizontal cuts in the bark, in the form of a rather viscid emulsion, and may be collected from April to October. In the spring it will be more watery than in the later months. It exudes slowly, and is collected by means of a pointed, spoon-like instrument, and transferred to a wooden receptacle or tube of bamboo. Several cuts are made in each tree, the last as high as a man can reach. Having thus prepared a dozen or more trees in rapid succession, the collector begins to collect the juice from the cuts in regular order, beginning with the one first cut. Having finished the collecting, he takes other groups of trees, and after about four days returns to the first, where, after removing the accumulated yield, he cuts again into the same trees, and repeats the same process fifteen or twenty times. Thus the work may go on for eighty to a hundred days.

As the sap first exudes, it is a grayish-white, thick, or viscous fluid, which quickly turns yellow, and afterwards black, where it is in contact with the air. The sap thus collected is *ki urushi*; *urushi* being

* Read at a meeting of the Washington Chemical Society.

the general name for lacquer. An inferior kind is obtained from the branches when the trees are cut down. The branches are soaked in water for several months, then taken up and slightly warmed, when a small quantity of sap exudes. This is seshime-urushi. The lacquer is strained through cotton cloth to free it from bits of wood and dirt, first being thoroughly stirred to break up lumps and make a uniform mixture. The product thus purified is known as seshime-urushi; but this name, which has already been used to designate the lacquer from the branches has now a different meaning, and is applied to the cheaper kinds of raw lacquer, such as are used for the first coats in lacquering. These lacquers have usually lost some of their water by stirring in shallow receptacles exposed to the sun. They have undergone no further preparation.

Many varieties are prepared for special purposes, ranging in price from one or two to six or seven dollars per kilogram. These differ in quality and color. There is a famous black lacquer prepared by the addition of iron, which forms a chemical combination to be mentioned further on; while red, green, yellow, and other colors are imparted by the addition of various pigments, as cinnabar for red, orpiment and indigo together for green, orpiment for yellow, etc. Certain lacquers have a small proportion of drying oil (perilla oil) added to them.

The most important and abundant constituent of lacquer is urushic acid, which occurs in the form of minute spherules. The acid is obtained by evaporating the alcoholic solution to a syrupy liquid. The evaporation must be carried on over a water bath. If too much heat be applied, a tough, black, rubber-like substance is obtained, which only strong nitric acid would affect in the slightest degree. Although the drying, or rather the hardening, properties of lacquer are doubtless due to the oxidation of urushic acid, the product extracted by alcohol possesses no drying qualities. This fact was first observed by Professor Rein in 1874. More recently Professors Korschelt and Yoshida have found that a peculiar albuminoid of lacquer effects the drying by a diastatic or fermentive action. The fact seems to be that the lacquer hardens only when the albuminous substance is present. If heated above 60° C., or above the temperature at which albumen coagulates, the lacquer will not dry. Besides urushic acid and the albuminoid, raw lacquer contains a gum resembling gum arabic, which doubtless imparts some useful properties to the lacquer, and a volatile acid to which Professor Rein ascribes the poisonous effects of lacquer.

A portion of raw lacquer, about 16 pounds, is poured into a large circular wooden vessel, and vigorously stirred with a long-handled tool for five or six hours, while the heat of a small charcoal furnace is ingeniously thrown upon the surface to evaporate the water. During the stirring certain ingredients may be added from time to time. The roiro, the fine black lacquer already mentioned, is made by adding iron at this stage. In Tokio a soluble salt of iron is used, but the Osaka manufacturer objects to that, asserting that it injures the quality of the lacquer. The material used in Osaka is fine iron dust collected from the grinding of knives. This is added in quantities of about a teacupful of powder mixed with water at a time until the desired color is obtained. When the work is finished the lacquer is poured into a vessel to settle, and is afterwards drawn off from the sediment.

BIOLOGICAL NOTES.

By J. H. PILLSBURY,

NORTHAMPTON, MASS.

Cockle Parasite.—Mr. M. L. Huct in *Bull. Soc. Linn. Normandie*, ser. 4, vol. ii, p. 145, 1889, describes a parasite found by him in the edible cockle, *Cardium edule*, which he considers identical with *Bucephalus haimeanus*, which is found in *Ostrea edulis* and *Cardium rusticum*, except that he is not able to discern an œsophageal tube which is described in that worm. He finds them during the months of Nov., Dec., Jan., and Feb., in about 4 per cent. of the cockles examined.

Eudorina.—Mr. M. P. A. Dangeard in the same publication, p. 124, describes the method of formation of antherozoids directly from "green globular cells resembling the vegetative cells and oospheres." This he says is an addition to the ordinary method of forming antherozoids.

Examination of Sputa.—W. H. Bugtold, M. D., has a valuable article in the April number of *The Microscope* on this subject. The writer enumerates the various ingredients of normal sputum and the more important organisms which are likely to be found as abnormal ingredients and indications of disease. Considerable space is given to the discussion of methods of treating *Bacillus tuberculosis* for microscopic examinations.

Organisms in Common Yeast.—Herr W. L. Peters, as a result of a series of examinations and cultures of baker's yeast, states that he finds it to contain generally three kinds of Blastomycetes and five of Schezomycetes. Of these forms *Saccharomyces minor* Engl., one unnamed species and *Mycoderma vini* are generally present; the latter in very small quantities in fresh yeast, but more abundant in stale yeast. A fourth form, *Saccharomyces cerevisiæ*, he found occasionally present, but by no means regularly. Of the Schezomycetes three forms were species of bacterium and two of bacillus, and these have to do with secondary or lactic fermentation.

"Some Habits of the Cray-fish."

By PROF. C. W. HARGITT,

OXFORD, OHIO.

Under the above title in the April number of the last volume of this JOURNAL there appeared an interesting account of a few of the habits of this crustacean by Prof. L. W. Chaney, of Carleton College. It is the purpose of this article to contribute certain additional facts bearing upon the subject, which have come under my notice during several years of laboratory experience, during which time the cray-fish has been an almost constant occupant of the aquaria. The observations, however, were not restricted to habits exhibited in these artificial homes. It abounds in the streams of the adjacent country, and may be observed at almost any time during at least eight months of the year; since it leaves its hibernating quarters at the first sign of spring, and only re-

turns with the freezing weather of late autumn. During these months it is almost constantly busy in its round of life-habits, comprised chiefly in foraging for a livelihood and in propagating its kind.

It goes almost without saying, that next to the frog the cray-fish furnishes one of the most important subjects for the zoölogical laboratory in all our inland colleges. Its abundance in most inland waters makes it easily accessible, and as a type of arthropod, and especially crustacean life, few forms, if any, are better suited to elementary work.

Prof. Huxley, in that admirable book, "The Cray-fish," aptly designates it "An Introduction to the Study of Zoölogy." And perhaps few subjects have contributed more to the intense interest which centres in this science, among beginners, than has this miniature lobster of the fresh waters.

Prof. S. A. Forbes has also pointed out* the admirable facilities afforded by the smaller forms of crustacea for the study of the "leading facts of physiology." The minute size and transparency of *Asellus* or *Crangonyx* making it comparatively easy to observe "at leisure, under a low power of the microscope, the respiratory movement, the circulation of the blood, the motions of the heart, and the actions of its valves, the contraction and relaxation of muscular fibre, the process of digestion, as well as the general and minute anatomy of the entire animal."

It may perhaps be worth while to notice in passing that the finest specimens for general laboratory purposes may be obtained by excursions to the smaller streams and flat fields at the "spring thaw," especially during the usually accompanying period of large rainfall. It is at this time that the larger species of *Cambarus*, such as *gracilis*, *obesus*, etc., which hibernate in the banks and fields adjoining sluggish streams, venture boldly forth for the purposes of foraging, seeking new quarters, or more probably mating, and may be taken in comparatively large numbers.

Some of these species grow to large size, measuring in some cases from five to six inches from the tip of the rostrum to the end of the telson. With such specimens there is hardly more difficulty in dissecting even the smallest parts than with the lobster; leaving little to be desired as a fit introduction to arthropod zoölogy.

It need hardly be mentioned that they may be easily preserved in alcohol indefinitely, and are therefore easily accessible for laboratory purposes at any time. The only precaution at all necessary is ordinary pains to insure easy access of the preservation to every part. The dense, chitinous walls of the exo-skeleton must be in some way punctured to facilitate the process, or otherwise the internal organs will so deteriorate as to be useless for the study of either their gross or microscopic anatomy. I have found moreover that those specimens which had been injected in order to facilitate the study of the vascular system, a thing highly important and easily performed, were by far the best preserved. The injection had apparently greatly facilitated the access of the spirit to the more minute interstices of the tissues, probably by distention of the vessels in part, and in part by setting up an active process of osmosis at once, which extended to every part of the organism.

Any doubt upon this point may be easily dissipated by the very sim-

* Bulletin No. 1, Illinois Museum of Natural History.

ple process of experiment; and will, I am sure, amply repay whatever of effort it may involve, in the supply of material available at any moment; a thing of no small account to any one who has been the victim of disappointment just at the critical moment, which is no infrequent occurrence when depending upon fresh material for a special class demonstration.

Concerning the question raised by Prof. Chaney in the article before mentioned, as to its disposition toward living prey, I would record the fact that I have seen it attack living prey very vigorously. Living earthworms dropped near its retreat, or dangling from a hook, were instantly seized and eaten. I have noted the same disposition when confined in aquaria. This fact does not in any way militate against the view expressed of a seeming preference in some cases for a tainted diet. Such it undoubtedly has, in common with many of its congeners of the open beach and tide pools of the sea, where the habit may be observed at almost any time. What was before said of its disposition toward living animal prey will apply equally to growing vegetation; the stomachs of cray-fishes dissected containing fresh and green vegetable matter. Moreover, I have repeatedly fed cray-fishes in the aquaria with growing algæ and pond-weed which were voraciously devoured in large quantities.

Concerning the habits of reproduction there are various opinions entertained by observers, which would indicate that either this habit varies greatly in different localities, or that grave mistakes have been made by careless observers. It is not unlikely that something of both, together with the slightly varying habits of different species, may in a measure account for this difference.

That they will breed in confinement the following facts clearly demonstrate.

During the spring 1888, I captured a large number of full-grown specimens of cray-fishes, chiefly of the species of *Cambarus gracilis* and *C. obesus*, of both sexes, immediately upon the breaking up of the severe winter of that year, and their first issuance from the state of hibernation. They were placed in roomy aquaria where they remained for several weeks. During this time several pairs were found in copulation.

I have also in excellent state of preservation larval cray-fishes of the same species which were hatched in my aquaria, and were apparently as active and normal as those hatched in the natural habitat of the animals. It should be stated, however, that in this particular case the eggs had been laid before the mother was placed under the artificial conditions indicated, and that the young were hatched within a fortnight of the change. Whether the entire cycle from copulation to ovipositing and hatching might occur I am not prepared to state from actual observation. I have made the same observations upon the common shrimp, *Crangon vulgaris*, but not including the entire cycle of development. It would seem to be very strongly indicated therefore that with ordinary care they would freely breed to perfection under conditions of confinement.

There are likewise various accounts as to the mating season in different localities, due perhaps to reasons before suggested. Huxley indicates the season of mating as "October, or earlier for English species," while the months of November, December, and January are reported as the season in France. The facts cited already as to this process under artificial conditions would indicate a wide difference as to the habit among

the species of the United States. These facts are corroborated by numerous observations in a state of nature. I have never found them mating except in early spring; March and April, and sometimes in May. This is also the season of ovipositing. Only in two instances have I been able to get reports of females in "berry" at a later period than June; and in each case but a single specimen was found.

I have frequently found large males travelling considerable distances overland in the month of March to neighboring streams and ponds doubtless in response to the sexual instinct which is remarkably dominant at that time. In many cases the boldness with which such journeys were prosecuted in open daylight proved a fatal adventure, the daring subject falling a victim to the rapacity of the ubiquitous crow, to whose insatiable maw it appears to afford the special "delicacy of the season."

Finally, there appears to be considerable variation in different quarters as to the time of ecdysis.

Prof. Huxley, following the accounts of the older French observers, Réaumur, M. Carbonnier, and M. Chauveau, states this process as occurring ordinarily in adults in early autumn; or in the males perhaps twice during the year, in June and September. It has been reported as taking place in the cray-fishes of the west coast of Africa in December; at which time the "*soft craws*," as they are then called, are in great demand as an article of food.

While it has not been my fortune to directly observe the animal undergoing the throes of this ordeal, I have yet found them repeatedly within a short time of its occurrence, and while they were still quite limp and defenceless. This has invariably been in the *spring*, chiefly in May and early June. Furthermore, the cast skeletons are very common in the creeks, where the animals abound, during the spring and early summer in such perfect condition as to be easily mistaken for the living cray-fish. I have frequently so mistaken them while foraging for biological materials, and more than once have been undeceived only after a dextrous dip of the net brought the empty form to the surface. Now it is perfectly certain that no skeleton vacated during the previous autumn would so completely withstand the disintegrating action of the frosts and floods of winter and spring as to show no traces of the slightest disarrangement or disorganization of even the most delicate parts.

The brief outline and comparison of observations submitted in this review show considerable variation, if not discrepancy, in the records of different observers. Some reasons for this have already been indicated. Aside from the possible errors always likely to arise out of what has been termed the personal equation of the observer, the variations noted are not specially remarkable. Moreover, when we take into consideration the widely different conditions of the environments under which the observations noted were made, and also the usually slight variations of even closely related genera and species under similar, or but slightly different conditions, the differences of habit are not more than would ordinarily be expected, notwithstanding the remarkable and profound differences exhibited by the various *orders* of the class. That there remains much to be done in order to a thorough acquaintance of the life-histories of the crustacea is certainly obvious. If this sketch shall in anywise contribute thereto it will not have been in vain.

The Preparation of Nutritive Agar.

By V. A. MOORE, M. D.,

ASSISTANT IN THE LABORATORY OF THE BUREAU OF ANIMAL INDUSTRY, DEPARTMENT OF AGRICULTURE, WASHINGTON, D. C.

The extent to which nutritive agar is employed in the cultivation of bacteria renders it of much importance that its method of preparation should be made as perfect as possible. When it is prepared after the method recommended in works on Bacteriology (which is practically the same as that first formulated by Koch for the preparation of solid culture media), a medium is obtained that favors the growth of most germs. In this respect the method is desirable, but in regard to the other requisites of a satisfactory solid medium it is quite deficient. The objections to the method with reference both to the process itself and the character of the resultant agar are three in number. (1) The difficulties attending the filtration of the agar. This process alone often requires a very considerable length of time besides the use of a hot filtering apparatus that must be provided especially for this purpose. (2) The presence in the sterile agar of a flocculent precipitate that is invariably thrown down during the process of its sterilization and which greatly interferes with its usefulness, especially in making roll and plate cultures. (3) The variation in the consistency of the agar. It is impossible to obtain this material of the same consistency as the agar is only partially dissolved even after long boiling in the simple beef-infusion. The coagulation of the albumen ensheathes the stems of agar, floats them to the surface where they remain imbedded in the firm, albuminous coagulum. This property of the agar is worthy of consideration, for with the varying consistency of the medium a consequent change follows in the character of the growth of most germs.

For the purpose of securing a process for the preparation of nutritive agar that was free from the above-mentioned difficulties I have reviewed carefully the methods of Jacobi,* Von Freudenreich,† and Cheesman‡, in all of which I found difficulties that were equally as objectionable as those possessed by the original method.

The use of a solution of beef-extract in distilled water instead of the simple beef-infusion, made directly from the fresh meat, was also tried, but the agar thus prepared did not favor as vigorous a growth of many germs as when prepared from the fresh meat-infusion. So feeble was the growth of many germs upon this agar that the method was abandoned, although very satisfactory in other respects.

In the course of this experimental work it was found that when the stems of agar were cut into small pieces and boiled in a fluid containing no coagulable material, that it was entirely broken up and the soluble portion dissolved. The insoluble particles that remained suspended in the liquid were easily and completely removed by the addition of egg albumen, and subsequent boiling and filtering. From these facts a method for the preparation of nutritive agar was derived, which consists in first preparing the neutralized beef-infusion-peptone, and thus getting rid of all coagulable material before the agar is added. This process is effective in greatly diminishing the time and attention re-

* Centralblatt f. Bacteriologie u Parasitenkund III (1888), p. 538.

† *Ibid.*, p. 797.

‡ American Naturalist, XXII (1888), p. 472.

quired for the preparation of this medium. The medium can always be made of the same consistency, as all of the agar that is added is dissolved. It remains free from precipitates when sterilized, and its nutritive qualities are as favorable to bacterial growth as when it is prepared after the original method.

(1) *The preparation of the beef-infusion-peptone.*—The method of preparing this liquid is practically the same as that already in use in most laboratories. Finely chopped or ground beef (freed from fat) is macerated in distilled water for from 12 to 18 hours in a cool place. The distilled water is added in the proportion of 200 c.c. to each 100 grams of beef. On the following day the liquid is separated from the meat by straining it through a coarse linen. The simple beef-infusion thus obtained should be equal in quantity to the amount of water added; if it is not the deficiency can be restored by the addition of distilled water. To the beef-infusion is added 1 per cent. peptone, $\frac{1}{2}$ per cent. sodium chloride, and if it is desirable to make it alkaline a sufficient quantity of a normal solution of sodium carbonate to give it a weak alkaline reaction. The liquid is then boiled for thirty minutes in a water-bath, cooled, filtered, and distributed in Erlenmeyer flasks plugged with cotton-wool. If only a small quantity of agar is to be made at once, 250 c.c. is found to be a very convenient quantity to put in each flask. It is sterilized by boiling for one hour each day for three consecutive days. It need not be sterilized if it is desirable to prepare the agar at once. As the beef-infusion-peptone is also employed as a liquid medium in the cultivation of bacteria, very little time is lost in preparing an extra quantity of this liquid to be used in making the agar.

(2) *The preparation of the agar.*—To an Erlenmeyer flask (a glass-beaker or agate iron vessel may be used) containing beef-infusion peptone, as prepared above, 1 per cent. of *very finely-chopped* agar is added. The flask is then placed in a water-bath and boiled vigorously for two hours. At the end of that time the agar is all dissolved and the liquid is allowed to cool. When a temperature of 40–45° C. is reached, the white of egg is added in the proportion of one egg to 250 c.c. of the liquid. After the albumen is *thoroughly* mixed with the liquid agar it is returned to the water-bath and again boiled for two hours. It is of much importance that the albumen is evenly distributed throughout the mass before it is coagulated. It is now ready to be filtered. The egg albumen is coagulated in very firm masses, leaving the liquid perfectly clear. The coagulum is removed by filtering the liquid through fine Japanese filter paper or a layer of absorbent cotton, as a 1 per cent. solution of the agar does not pass readily through ordinary filter paper. Should a weaker solution of the agar ($\frac{1}{2}$ to $\frac{3}{4}$ per cent.) be desired, its filtration can be accomplished by the ordinary method. A hot filtering apparatus is not necessary. The clear filtrate is now ready for distribution in sterile, cotton-plugged tubes.

The agar is sterilized by discontinuous boiling in a closed water-bath for three consecutive days. If small tubes have been used containing not more than seven cubic centimeters each, five minutes boiling each day is sufficient. If larger tubes are used they should be boiled for a longer time. Or it may be sterilized by steaming each day for from five to ten minutes after the agar has become liquefied for the same number of days. After its sterility has been tested by allowing it to

stand in an incubator for several days, it is ready to be stored until required for use. It has been customary in this laboratory in order to prevent the evaporation of the agar by long standing to dip the lower end of the cotton plugs in hot, sterilized paraffine and to store the tubes in a cool, moist chamber.

A Simple Turn-Table.

By A. S. ELLIOTT,

BROOKLYN, N. Y.

Procure the frame and running gear of any cheap clock. Fifty cents will cover cost of all materials. Remove the mainspring from its place and make the wheel carrying it firm on the shaft. Remove all projecting parts from both top and bottom of frame. Reverse the centre wheel, putting the larger end of shaft uppermost, and making all bearings tight and smooth without oil. Cut a brass plate (soft) 3 inches in diameter; find centre bore, then bore two more holes $1\frac{1}{4}$ inches from centre; make a pair of light-bowed springs, solder to nail fitting such hole and fit tightly through plate, placing the clips in opposition to each other. Cut or scratch three concentric circles $\frac{1}{4}$, $\frac{1}{2}$, and $\frac{3}{4}$, turning table rapidly. Fit the centre shaft firmly to plate without soldering.

The apparent disadvantage of using a cogged wheel in turning with the hand is more than counteracted by the greater ease and consequent steadier rotation, together with greater speed attained by this table. Carefully made it will do as good or even better work than the ordinary form. If preferred the clips may be soldered fast to plate, but are rather unhandy.

The holes in the bottom of frame can be utilized to secure to firm base and hand rest in any convenient manner to suit the requirement of the maker.

376 GATES AVE., April 16, 1890.

MICROSCOPICAL SOCIETIES.

ESSEX Co., N. J.—F. VANDERPOEL, *Sec'y*.

December 19.—The December meeting was held at the residence of Mr. Albert Mann, East Orange. The paper was by Rev. Mr. Mann, who presented the subject of Diatoms under the following heads: Their classification, Life-History, Gathering and Preparation, etc.

The classification of the diatoms had become very much confused in consequence of many investigators creating hosts of new genera to include the multitude of forms discovered which were multiplied and caused to overlap each other. Some few investigators, however, have done effective work in reducing these genera and thus simplifying matters. Prof. H. L. Smith has probably done more in this direction than any other diatomist. The subdivision of the Diatomaceæ into tribes, according to Prof. Smith, was given and illustrated by lantern slides. Under the head Life-History, three points were discussed, viz: Reproduction, Structure, Movements of the Diatoms, the first two being quite fully illustrated by the lanterns. In referring to the reproduction of

Diatoms the speaker was positive, after a visit to Prof. S. Lockwood, that his ingenious theory of reproduction by spores is a theory only.

With regard to the movements of diatoms, Mr. Mann said that he could bring forward nothing but improved hypotheses and unanswered questions. No theory seemed adequate to the case. Even the most popular theory put forward failed to account for some erratic movements in diatoms, such as the whirling of naviculæ on end, and the running of particles of foreign matter along the raphe in the direction of the motion of the diatom. Both of these conditions were shown with living forms under the microscope. The subject of the preparation of diatomaceous gatherings was omitted on account of the lateness of the hour. About seventy lantern slides, mostly prepared by the lecturer for the occasion, accompanied the remarks.

After the conclusion of the paper by Mr. Mann, the Secretary resolved *A. pellucida* in Smith's medium by light reflected from the concave mirror, the latter being *above* the stage, and the cone of light impinging on the cover-glass. The objective used was a $\frac{1}{15}$ " Hom. Imm. The illumination of the diatom was probably by some sort of internal (total) reflection in the mounting medium, for the front of the objective was too wide and too near the object to allow the light to reach the latter directly. The same resolution can be obtained, using the bull's-eye condenser instead of the mirror.

January 9, 1890.—The members met, as guests of Mr. H. F. Crosby, at the Montclair Club. The paper for the evening was prepared and read by Dr. Henry Power, the subject being Bacteria. He went into the history of these forms of life from the time when they were first studied down to the present day, and spoke of the labors of most of the prominent bacteriologists, giving the different methods of culture, staining, etc., and illustrated his lecture with a large number of micro and lantern slides. The classification of the different forms was also illustrated by means of the blackboard. The paper was an excellent one and handled the subject very clearly.

February 20.—Meeting held at the residence of Dr. Chambers in East Orange. Dr. George S. Allan read a paper in reply to an article by Dr. Jacobs, published in *The Microscope* last June, said article criticising the experiments of Dr. Miller, of Berlin, upon decaying teeth, and the conclusions at which he had arrived with regard to certain causes connected therewith.

March 6, 1890.—Met at residence of the President, Mr. J. L. Smith, in South Orange. The subject for the evening was Pus. The members listened to a very instructive and entertaining talk upon this subject by Dr. Stickler, of Orange, who, during the course of his remarks, referred to the varying opinions of medical men of to-day, notably those of Dr. Paget, the eminent English surgeon, who does not agree with those who hold to the idea that pus cells and white blood corpuscles are identical. The former are larger, denser, and more granular than the latter. Their reaction with acetic acid is different. After treatment, however, their appearance under the microscope is similar to that of the leucocytes. The pus from a healthy person is clear, shining, and yellow, while that from a pyæmic patient will be flattened out or broken down, the cell wall ruptured, and a great deal of granular matter within the cell. In fact, the appearance is similar to that of carious bone.

Dr. Stickler then gave a list of the different bacteria which had been found in pus. It included:

1. A streptococcus (in pus from acute abscesses, which, upon inoculation, will cause the death of lower animals in from two to ten days).
2. Micrococcus pyogenus aureus found in pus from puerperal fever, boils, osteo-myelitis, etc., and is very poisonous.
3. Streptococcus, not as poisonous as the last.
4. Bacillus of fetid pus; very poisonous.

Following the paper a specimen of urine from a patient suffering with cystitis, was exhibited by Dr. Runyon, and the pus cells examined.

BOOK NOTICES.

The Modern Theory of Heat, and the Sun as a Storehouse of Energy. By Gerald Molloy, D.D. The Humboldt Publishing Co., 28 Lafayette Place, New York. (Price 15 cents.)

This work is equally as interesting as the preceding one by the same author, and is gotten up in the same style.

Upon the Origin of Alpine and Italian Lakes, and upon Glacial Erosion. A series of papers by Sir A. C. Ramsay, F. R. S.; John Ball, M. R. I. A., F. L. S., &c.; Sir Roderick Murchison, F. R. S., D. C. L.; Prof. B. Studer; Prof. A. Favre; Edward Whymper. Introduction by Prof. J. W. Spencer. The Humboldt Publishing Co., 28 Lafayette Place, New York.

The rapid progress of the science of Geology at the present day justifies the reproduction of this series of papers contributed at various times by the distinguished writers whose names are given. No one desirous of being well-informed can afford to neglect this important study of Geology, which many scientists claim disproves the Mosaic cosmogony. The present work is in two parts, a double number and a single number. (Price for both, 45 cents.)

Chemical Reagents and Spectroscope. By Chas. O. Curtman, M. D. 8°, pp. 256. John L. Boland, St. Louis, Mo. (Price, cloth, \$1.75.)

It was to obviate the difficulty experienced by all engaged in analytical work of obtaining some of the rarer reagents, or in procuring those on the market of the necessary degree of purity, that prompted Dr. Curtman to compile the present volume. This book, as the author says, is not intended to be a guide to analysis, or to compete in any way with the standard works upon the subject, but rather to serve as a supplement to them to aid the analyst in selecting, testing, and preparing the reagents he needs, and to gather into a single volume information now scattered over a vast extent of chemical literature.

In most cases the tests for the absence of all impurities are given, and from these may easily be selected only those which are essential to a special purpose, as it rarely happens that absolutely pure reagents are necessary; generally it is the absence of certain impurities only that is required to render the reagent serviceable. The arrangement of the

volume is systematic and convenient. That adopted in most cases is to give, first, the use of the reagent; next, tests for its purity; and, lastly, such methods of preparation as are suitable for making smaller quantities for laboratory use. The volume is supplemented by an index, and also by a list of tests arranged under the names of the substances to which they are applied. A number of plates are introduced to illustrate the text, and to aid in a clear apprehension of the apparatus described.

As the spectroscope is daily becoming a more prominent aid to analytical research, a short chapter has been very properly added, describing the simpler and inexpensive forms usually employed in the laboratory.

SUBSCRIBERS' NOTICES.

[These notices will be given six insertions in this column at 25 cents per line or fraction thereof.
FOR EXCHANGE.—Slides of selected diatoms. D. B. WARD, Poughkeepsie, N. Y.

WANTED.—Unmounted microscopical material, also micrographic dictionary. Will exchange or buy. CHARLES VON EIFF, 124 Clinton Place, New York City.

WANTED.—A clean copy of Rev. William Smith's British Diatoms, and Schmidt's Atlas of the Diatomaceæ. JAMES B. SHEARER, Bay City, Mich.

OFFERED.—Diatomaceous Earth from Utah (Desert) for Histological Mounts. PROF. ORSON HOWARD, Salt Lake City, Utah.

CORRESPONDENCE invited with a view to the exchange of either mounted or unmounted Oribatida (British) for American species. E. BOSTOCK, Stone, Staffordshire.

WANTED.—Any works on Microscopy not already in my Library. H. M. WHELPLEY, F. R. M. S., St. Louis, Mo.

Labels in exchange for slides. EUGENE PINCKNEY, Dixon, Ill.

First-class Histological Slides for other good mounts; Histological and Pathological material cut on shares. S. G. SHANKS, M. D., 547 Clinton Ave., Albany, N. Y.

OFFERED.—Griffith & Henfry Micrographic Dictionary to be sold; also Hoggs Microscope. J. P. WINTINGHAM, 36 Pine St., N. Y.

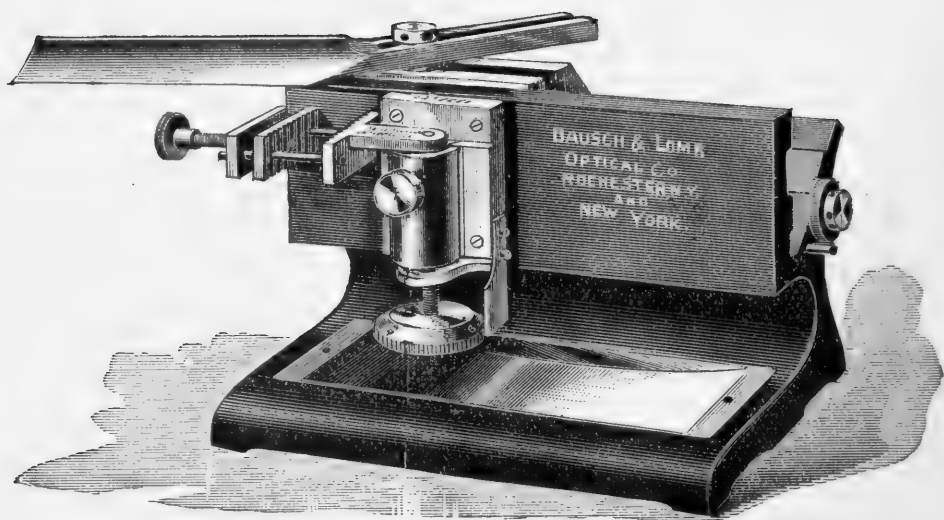
WANTED.—A clean copy of Wolle's Fresh-Water Algæ of the United States (2 vols.); also good second-hand Grunow Camera-Lucida, and a self-centering Turn-table. JOS. P. THOMPSON, P. O. Box 1383, Portland, Me.

FOR SALE CHEAP.—New Gundlach $\frac{1}{8}$ homogeneous-immersion objective, for $\frac{1}{10}$ glycerine or water objective. J. M. ADAMS, Watertown, N. Y.

FOR SALE.—A Bausch & Lomb Stand, A. & C. eyepieces, 1 in. and $\frac{1}{2}$ in. objectives. BOX 1, Evanston, Ill.

FOR EXCHANGE.—Cabinets of lower silurian fossils for microscopical apparatus or objects. Correspondence invited. E. L. SHERWOOD, Houston, Miss.

OFFERED.—\$400 in prizes. For details see article in January number of this journal for 1890. C. A. STEPHENS, Norway Lake, Me.



BAUSCH & LOMB'S MICROTOME.



THE GRIFFITH CLUB MICROSCOPE.

THE AMERICAN MONTHLY MICROSCOPICAL JOURNAL.

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All communications for this Journal, whether relating to business or to editorial matters, and all books, pamphlets, exchanges, etc., should be addressed to American Monthly Microscopical Journal, Box 630, Washington, D. C.

European subscriptions may be sent directly to the above address accompanied by International Postal Order for \$1.15 per annum, or they may be sent to Messrs. Trübner & Co., 57 Ludgate Hill, London, or to Mr. W. P. Collins, 157 Great Portland street, London, accompanied by the yearly price of five shillings.

Griffith Club Microscope.

BY E. H. GRIFFITH, F. R. M. S.,

FAIRPORT, N. Y.

[WITH ONE PLATE.]

This is a full-sized, first-class monocular, made of brass, steady when in position, free from tremor, unique in design, and beautiful in appearance. It has a draw-tube with society screw, a superior rack and pinion and a delicate micrometer adjustment, allowing the greatest range of objectives; substage ring and revolving diaphragm, graduated adjustable mirror-bar that may be set at any angle above or below the stage, giving any obliquity of illumination; plane and concave mirrors, glass-faced thin stage with the clips supported above it on a bar, allowing the use of the entire surface.

Among the original features are the turn-table base, making one of the best turn-tables in use; the adjustable lamp for class and exhibition purposes; the micrometer adjustment, giving a range of nearly three inches and which locks the rack when in use, making a safeguard for valuable slides; the clips which may be turned simultaneously upward on an axis out of the way, and its portability.

The microscope is provided with a Morocco-covered, velvet-lined case, with the turn-table spindle ready for use, and with receptacles for objectives.

The strongest endorsement that can be given the microscope is the fact that it is owned by a large percentage of the officers and members of the American Society of Microscopists, members of the Royal Microscopical Society, and by other expert microscopists.

The stand is furnished with $\frac{3}{4}$ inch and $\frac{1}{2}$ inch objectives.

EXPLANATION OF PLATE.

FIG. 1.—Bausch and Lomb's Microtome.

FIG. 2.—Griffith Club Microscope.

Copyright, 1890, by C. W. Smiley.

The Annual Soirée of the Washington Microscopical Society.

BY ROBERT W. SMILEY,

WASHINGTON, D. C.

The sixth annual soirée of the Washington Microscopical Society was held in the halls of the High School building on the evening of April 22. The success of the event was very gratifying to the officers of the Society. A large audience of nearly 500, after listening with pleasure to the address of the president, dispersed through the corridors to view the interesting objects displayed, many of which called forth exclamations of delight and wonder. The following exhibits were made:

By Dr. G. N. Acker, with Zeiss and Hartnack: Œsophagus and stomach of rabbit.

By Dr. E. A. Balloch, with Zentmayer (binocular): Skin of frog (injected).

By Dr. I. W. Blackburn, with Zentmayer: Carcinoma (cancer) of the heart.

By Mr. E. S. Burgess, with B. & L.: Leaf structure, showing cells, stomata, and chlorophyl granules; and fresh-water algæ (water-mosses).

By Dr. C. T. Caldwell, with B. & L.'s Universal and Harvard: Mosquito eggs, and eggs of bot-fly (*Gasterophilus equi*) attached to horse hair.

By Mr. F. T. Chapman, with B. & L.: Electric spark through metal filings.

By Dr. A. B. Coolidge, with B. & L.: Shells of embryo oyster.

By Dr. H. A. Dobson, with B. & L.: Polycistina from Barbadoes.

By Mr. H. H. Doubleday, with Crouch (binocular) and Zentmayer: Crystals of amygdalin (polariscope) and insect eggs.

By Mr. Walter C. Duff, with B. & L.: Various parts of the honey-bee.

By Dr. J. M. Flint: Foraminifera.

By Mr. Richard Foster, with Crouch: Aphides.

By Dr. E. A. Gibbs, with Beck and B. & L.: Circulation of blood in frog, arsenious oxide.

By Prof. R. Hitchcock, with Bulloch and Schrauer: Cyclosis (circulation of sap in plants) and scales on back of beetle.

By Dr. D. S. Lamb, with Beck and B. & L.: Transverse section of bone, and diatoms (so arranged), with names photographed beneath.

By Dr. J. M. Lamb, with B. & L. and Queen: Blood corpuscles—human, guinea-pig, amphiuma, and frog.

By Dr. Collins Marshall, with Acme No. 3: Foraminifera.

By Mr. Lewis Mooers, with Seibert: Salicin and saccharin (polariscope).

By Dr. V. A. Moore, with Zeiss No. 1: Section of tubercle from pleura, showing tubercle bacilli.

By Dr. S. J. Radcliffe, with Beck: Injected lung, showing capillary distribution.

By Dr. Robert Reyburn, with Beck and Acme No. 5: Eggs of water-snail (*Lymnaea stagnalis*) and green hydra (*Hydra viridis*).

By Dr. H. A. Robbins, with Reichert: *Trichina spiralis*.

By Dr. W. H. Seaman, with B. & L. and Beck : Section of fossil limestone and circulation of blood in fish.

By Mr. A. N. Skinner, with Zentmayer : Textile fibres—silk, linen, cotton, and wool.

By Mr. C. W. Smiley, with Crouch : Dorsal and ventral views of embryo star fish.

By Dr. C. H. Stowell, with Beck : 250 arranged diatoms, with photo-micrograph of the same, and lady's pin, with finely ruled bands.

By Dr. Thomas Taylor, with Acme No. 3, Zeiss, and B. & L. : Stone cells of tea leaf, tea leaf hairs, serrations, and cluster of hooks in embryo tape-worm in heart of hog.

By Dr. W. H. Wilmer, with Schrauer : Stomach of frog.

By Dr. L. D. Wilson, with B. & L. : Sea-weed.

By Mr. J. M. Yznaga, with B. & L. : Butterfly scales arranged in form of bouquet.

Although many of these exhibits from a scientific point of view would be considered of little value, yet they have a decided influence in educating the public to a just appreciation of the science of microscopy.

Some Practical Business Applications of the Microscope.

BY DR. FREDERICK GAERTNER,

PITTSBURGH, PA.

The man who has learned the use of the microscope has certainly gained a great deal, but the man who claims to be a scientist without knowing the practical value of the microscope and without having learned its use ought not to be classed as such. The microscope when first invented was considered as an accessory or a plaything. But since 1820 and later (1840) the first European oculist and scientist began to make microscopical researches, not only in the medical profession, but also in botanical, geological, and other studies. Since 1860 and 1870, the world over, the microscope has been applied to almost every study and analysis. Had Galen, Celsus, and Hippocrates, and other ancients, had the use of the microscope they would not have advocated the theory that the arteries in the human being contained air during life, instead of oxygenized blood. They were of the erroneous opinion that the blood simply acted as a humor in lubricating the tissues. Had it not been for the microscope, James Paget, the great English surgeon and physician of St. Bartholomew's Hospital, in the year 1834, would not have discovered the *Trichina spiralis*, which had already slaughtered its thousands, dating as far back as the time of Moses.

The microscope is certainly the greatest aid a scientific and a professional man can have. A physician without a microscope is like a man without his hands ; he is uncertain and unprotected. He cannot arrive at a correct and positive conclusion in diagnosing and prognosing his cases. It is important to have the microscope at hand for examining the sputa of human beings, so as to be able to state positively whether or not the man is suffering with consumption (tuberculosis). It is important to be able to determine with a certainty, at an early date, whether or not a man is suffering with cancer of the stomach by examining the vomits. A microscope magnifying from 1 to 5,000

diameters is a most simple piece of apparatus. Every person can learn its use in a few hours. Every person should learn to use a microscope, not only the professional man and scientist, but every business man, even the grocer, butcher, farmer, and the housewife.

Everything that concerns a medical examination in a legal sense, or a legal examination in a medical sense, can be determined accurately by the use of the microscope. For example, in the Cronin case of Chicago, where the medical experts demonstrated to a certainty that the blood, hair, and brain matter found in the Carlson cottage and sewer trap, was that of a human body. Not only that, but they determined accurately and positively that the hair and blood found in the cottage and in the fatal trunk were that of Dr. Cronin, only in a modified condition; all with the aid of the microscope.

Within the last decade scientists have demonstrated to a certainty the possibility of determining dried and old human blood-spots from that of animal blood, whether on clothing, wood, iron, or otherwise.

Pathologists and histologists have also demonstrated the great value of the microscope in determining positively the skin, hair, blood, brain matter, also the excretions and secretions of the human being from that of the lower animals.

Again, the microscope is applied in a medico-legal view, especially in malpractice, suits of damages, suits involving, rather than determining the adulteration of foods and drink as to their purity, and finally, in determining whether or not food or drink has spoiled, undergone fermentation and the accumulation and development of micro-organisms, such as germs, microbes, and bacilli. Also, in the examination of oleo-margarine and in the adulteration of drugs, liquors, milk, groceries, sausages, etc.

The application of the microscope in a legal point of view is altogether new. We anticipate surprising effects from the application of the microscope in the examination of legal documents, U. S. currency, and printed matter.

The following lines are from a very ample paper read by G. E. Fell, M. D., before the American Society of Microscopists, entitled "Examination of Legal Documents with the Microscope."

More than once has investigation with the microscope cleared up the path of the attorney, ferreted out the work of the contract falsifier, and shielded the innocent from the unjust accusations of interested rogues.

The range of observation in investigations of written documents with the microscope is a broad one. We may begin with the characteristics of the paper upon which the writing is made, which may enable us to ascertain many facts of importance; for instance, a great similarity might indicate, with associated facts, that the documents were prepared at about the same time. A marked dissimilarity might also have an important bearing upon the case.

The differences in the paper may exist in the character of the fibres composing it, the finish of the surface, whether rough or smooth, the thickness, modifying the transmissibility of light, and the color, all of which may be ascertained with the microscope.

The ink used in the writing may be examined. If additions have been made to the document within a reasonable time of its execution, it is well to examine it microscopically with a great probability of detect-

ing the differences of the original and additional inks. These differences may be present, as follows: Some inks in drying assume a dull or shiny surface. If in sufficient quantity the surface may become cracked, presenting, when magnified, an appearance quite similar, but of a different color, to that of the dried bottom of a clayey pond after the sun has baked it for a few days. The manner in which the ink is distributed upon the paper, whether it forms an even, somewhat regular, border or spreads out to some extent, are factors which may also be noted. The color of the ink, by transmitted or reflected illumination, is a very important factor. This, in one case, proved of great importance, and demonstrated the addition of certain words, which completely annulled the value of the document, involving several thousand dollars. And in a case where the lines of a document were written over with the idea of entirely covering the first written words, the different colors of the ink were concealed from the magnified image as seen under reasonable low powers of the microscope.

Special attention is desired to the examination with the microscope of written documents, United States currency, printed matter, etc., as to their genuineness from a legal standpoint. The principal feature in the examination of written and printed documents is in the erasures and the additions, in the different coloring of different inks applied, and the mode of their execution.

Erasures can be accomplished either with a knife or by a chemical preparation. The former process is the one commonly resorted to, and is effected in the following manner: With a well sharpened knife-blade the surface of the paper is carefully scraped until all objectionable lettering and wording is supposed by the naked eye to have disappeared. With a microscopical examination you can at once detect the impression made by the stroke of a pen. Even the different colors of the ink are still to be seen with the microscope.

The second method being by a chemical preparation. The ink is made soluble and then easily removed from the paper by means of a blotter or absorbent cotton. This method is also an incomplete one, and the letters can easily be made out by close observation, where a chemical preparation has been used for erasing. In most cases it leaves a stain, and the fibres of the paper are more or less injured by the chemicals used, always leaving evidence that the document has been tampered with.

Geo. E. Fell, in his paper, says the eye of the individual making the erasure is certainly not sufficient, and even with the aid of a hand magnifier the object might not be effectually accomplished. The detection of an erasure made by the knife is a very simple matter, and may be accomplished by the novice. An investigation may be made by simply holding the document before a strong light, and this is usually all that is necessary to demonstrate the existence of an erasure of any consequence. This is, however, a very different matter from making out the outlines of a word or detecting the general arrangement of the fibres of the paper, so as to be enabled to state whether writing has been executed on certain parts of the document. Again, when we enter into the minutiae of the subject, we find that the compound microscope will give us results not to be obtained by the simple hand magnifier.

On several occasions I have had the opportunity of demonstrating

with the microscope additions made to certain documents, two of which were wills. The additions were made in the following manner (which the microscope revealed) : First, an erasure must have been produced, then there was a writing over the erasure. With the microscope you could at once detect the erasures and the additions ; also the different colors of the inks used, and, next, the most important characteristic of the microscopical examination being in the close observation of the stroke of the pen of the original lettering and the additional lettering, and, finally, the general mode of their execution.

In the examination of legal documents, U. S. currency, printed and mutilated documents, including forgeries, etc., involving a legal question and investigation, the principal features in the microscopical examination as already stated are the erasures, additions, color of the ink, stroke of the pen in the original lettering and additional lettering, and, finally, the mode of their execution. This includes the general and comparative expression of the original writing, that is, in the observation of the letters constituting the document. Especial attention is needed in the observation of the shading, and in the general formation of the letters by the stroke of the pen either in a downward or upward movement. This applies not only to the capital letters, but also to the smaller letters, even to the punctuation, grammatical and orthographical relationship, and in comparative differentiation. All these things must be taken into consideration.

In the examination of papers, documents, such as wills, notes, checks, etc., as to whether or not they were mutilated and forged, the microscope will certainly be the most reliable test, much the easiest and simplest.

This is the way of determination, and an expert microscopist and observer can at once arrive at a correct and positive conclusion as to the genuineness of the autograph, etc.

In the examination of U. S. currency the same will hold good as in the examination of written and printed matter, with the exception that additional observation is necessary in order to differentiate a genuine bill from a counterfeit. This lies in the microscopical examination (1) of the quality of the paper used ; (2) in the execution and finish of the bill ; (3) the grade and color of the ink ; (4) the printed condition of the bill, including the autograph ; (5) the most important and characteristic means of determining a genuine bill from a counterfeit bill being in the observation of the red line which runs lengthwise across the bill, and it will be necessary to notice that the two red lines in a genuine bill are simply red silk thread interwoven in the paper of the bill, when in a counterfeit the red lines are simply red ink stripes and no silk lines whatever.

Study of Animalculæ.—The Midland *Naturalist* for May, 1890, contains a sprightly and very interesting lecture by George J. Burch, B. A., Oxon., on the Cilia of Animalculæ, as seen by Flashing Light. The home-made apparatus used is simple, cheap, and ingenious. To any one studying the Rotifers the article cannot fail to be of value.

Paste Eels.—It may not be generally known that vinegar eels and paste eels are identical, the greater vigor of the latter being due to the more nutrient qualities of the paste.—*The Observer*.

American Society of Microscopists—Detroit Meeting.

BY GEO. E. FELL,

BUFFALO, N. Y.

The next meeting of the Society will be held at Detroit, Michigan, August 12 to 15, inclusive. The outlook is most encouraging, as will be seen from the papers already promised. The general session for the reading of papers will be held in the elegant new building of the Detroit College of Medicine, corner of St. Antoine and Catherine streets and Gratiot avenue.

Tuesday A. M., August 12, 1890.—The Convention will open. The Mayor of Detroit will deliver the address of welcome, to be followed by the response of the President of the Society. The afternoon session will be devoted to the reading of papers and society business. In the evening will be held a conversazione at hotel headquarters.

Wednesday, August 13.—Forenoon and Afternoon: Reading and discussion of papers and special topics. Evening: Annual address of the President: Subject, "The Influence of Electricity on Protoplasm."

Thursday, August 14.—Forenoon: Reading and discussion of papers and special topics. Afternoon: Working session devoted to the various technological features of microscopy as preparing, staining, mounting of specimens, section-cutting, manipulative methods, etc. These demonstrations are conducted by experts in the different branches of work, and form a valuable feature of the meeting. Evening: Exhibition of Microscopes and Objects. Popular in character, and tendered by the Society to the citizens of Detroit.

Friday, August 15.—Forenoon: Reading of papers, discussions, society business. Afternoon: Reading of papers; discussion until 4 P. M. Trip on the Detroit River, followed by an inspection of the laboratories of Park, Davis & Co. (by invitation). Adjourned exercises.

(The members of the Society are specially requested that the enquiry cards relating to the exhibition and working session be filled out and promptly returned. Through this courtesy the officers of the Society are apprised of the receipt of the circular and of the probable attendance; and their labor, which is quite extensive, is thereby somewhat lightened.)

Hotels.—The headquarters of the Society will be at the Hotel Normandie, prices ranging from \$2.50 to \$3.00 per day. The Russel House and Hotel Cadillac are also open to the guests, at prices from \$3.00 to \$4.00 per day. Cheaper accommodations may be obtained at boarding-houses at rates from \$1.00 upwards per day.

Subjects for Discussion.—Representation of the Society at the World's Fair, Chicago, 1893. Discussion to be opened by Ex-Gov. Jacob D. Cox, Cincinnati, Ohio; Micrometry, by Prof. William A. Rogers, Waterville, Me.; Proposed Standing Committee on Medico-Legal Microscopy, by Prof. Marshall D. Ewell, Chicago, Ill.; Uniformity in Tube Length, by Prof. Simon H. Gage, Ithaca, N. Y.; The Advisability of Adding more Members to the Publication Committee, by Prof. D. S. Kellicott, Columbus, Ohio; Proposed New Constitution, by Dr. William J. Lewis, Hartford, Conn.; The Advisability of Meeting at same time and place of the American Association for the

Advancement of Science, by Prof. W. H. Seaman, Washington, D. C. ; Advisability of Sending Copies of the Publications to some of the great Colleges and Libraries of the World, by Dr. Lee H. Smith, Buffalo, N. Y. ; Fees of Experts with the Microscope, by C. M. Vorce, Esq., Cleveland, Ohio.

Papers.—The following titles of Papers to be read have been received up to the present time :

The Full Utilization of the Capacity of the Microscope, and Means of Obtaining the Same, by Edward Bausch, Esq., Rochester, N. Y. ; (1) The Structure of Protoplasm, (2) Microscope Objectives, by Prof. T. J. Burrill, Illinois State University, Champaign, Ill. ; (1) Some Abnormal Forms of Diatom, (2) The Generic Marks of *Goscinedicus*, and some Allied Genera of Diatoms, by Ex-Gov. Jacob D. Cox, Cincinnati, Ohio ; (1) The Microscopic Identification of Hair, (2) The effect of Curvature of the Cover Glass upon Micrometry, (3) Description of Scale (5) Manufactured by Marshall D. Ewell, in pursuance of resolution of A. S. M., adopted in 1889, (4) A New Form of Stage Micrometer, (5) Some Experiments to Determine the Limit of Vision as Related to the Size of the Object Observed, (6) A Review of some of the Medico-Legal Questions Involved in the Cronin Case, by Prof. Marshall D. Ewell, Chicago, Ill. ; Observations on the Blood in Health and Disease, by Dr. Simon Flexner, Louisville, Ky. ; (1) The Transition from Columnar to Stratified Epithelium, (2) Picric and Chromic Acid for the Rapid Preparation of Tissues for Classes in Histology, by Prof. Simon H. Gage, Ithaca, N. Y. ; (1) The Rotifera of Central Michigan, (2) Recent Methods of Investigating Microscopical Animals, by Prof. D. S. Kellicott, Columbus, Ohio ; Some Methods of Treating Nerve Tissue, by Dr. William C. Krauss, Buffalo, N. Y. ; (1) An Infallible Method of Preparing Injecting Gelatine and Injecting Small Animals, (2) Observations on Mounting, by Dr. R. N. Reynolds, Detroit, Mich. ; Résumé of the Past Year's Advance in Microscopy, by Dr. Lee H. Smith, Buffalo, N. Y. ; (1) A New Flash Light in Photography as Applied to Microscopy, (2) Postal Cards and Vegetable Fibres, (3) The Possibilities of the James Cement, with Many Fine Specimens, by Dr. Thomas Taylor, Washington, D. C.

Papers are promised by other prominent workers. All who propose reading papers are requested to fill out the blanks and forward them to Secretary Burrill. These suggestions apply also to the blanks for membership. A marked increase in membership is looked for at the Detroit meeting. Admission fee, \$3 ; annual dues, \$2, payable in advance.

Completion of manuscript prior to meeting will greatly aid the publication committee. Papers read before the Society may be published in any reputable journal, provided due acknowledgment is made that they are from the Proceedings of the American Society of Microscopists.

Negotiations relating to reduced railroad fares have been in progress. Should they be successful due notice will be given.

The local committee at Detroit will issue circulars relating to the working session and the exhibition. They will supply badges and look after the general welfare of those attendant upon the Convention.

The Preparation of Microscopical Sections from Barks and Roots.*

By M. J. COLE.

Barks and roots that have been dried must be cut into small pieces and soaked in water for several hours; this will cause the tissues to swell up and regain, to a certain extent, their natural shape. They are then to be transferred to methylated spirit or alcohol, which should be changed every twenty-four hours until no color comes from the tissue. They will then be ready for cutting into sections, or they may remain until required.

Fresh specimens should be cut into small pieces and placed in spirit, which should be changed as above until no color is given off from the tissue. The hardening will usually be complete in a week, or they may remain for any length of time until required for cutting.

Some barks will be found too hard to cut; they may be softened by soaking for a time in liquor potassa; then wash well in water until all trace of potash is removed.

Section Cutting.—Fairly good sections may be made by hand with an ordinary razor. Hold the piece of tissue in the left hand, keeping the forefinger straight so that it may form a rest for the blade of the razor to slide on. A good strong army razor answers very well. Hold it firmly in the hand and keep the handle in a line with the blade and draw it from the heel to the tip through the tissue toward yourself. Keep the blade well wetted with dilute spirit, and as the sections are cut place them in a saucer of spirit of water.

Section Cutting with a Microtome.—If really good sections are required, a microtome of some kind should be employed. Screw the microtome to a firm table, and with the tube supplied with the machine, punch out a cylinder of carrot to fit the well of the microtome. Cut this in half longitudinally, and scoop out sufficient space in one half to take the tissue to be cut. Put the other half of the carrot in its place, and make sure that the tissue is held quite firmly, but it must not be crushed. Now place the whole in the well of the microtome, and commence to cut the sections with a strong razor or the section knife that is supplied with the machine when desired. Keep the blade of the knife well wetted with dilute spirit, and as the sections are cut place them in a saucer of spirit of water.

Bleaching.—Vegetable sections generally require bleaching before they can be properly stained. A solution of chlorinated soda is usually used. Soak the sections in distilled water to remove the alcohol. Pour off the water and add a quantity of the bleaching solution, and allow it to act for from three to twelve hours, or until all color has disappeared from the sections; then transfer to water, which must be changed several times until all trace of soda is removed.

Staining Sections.—The best staining fluid for general purposes is logwood. Take two ounces of ground logwood chips, place them in a calico bag and run water through it until scarcely any color comes away. Drain away as much water as possible, remove the logwood from the bag and spread it in a thin layer on a tray to dry. Dissolve 2 drams of potash alum in 12 ounces of distilled water. Put the log-

* Read at a meeting of the London Chemists' Assistants' Association.

wood into a vessel, pour on the alum solution and let stand for forty-eight hours. Strain through muslin and add four ounces of glycerine and one ounce of rectified spirit, mix well together, filter through paper, and add a small lump of camphor to make the mixture keep.

Add from 30 to 40 drops of logwood solution to one ounce of distilled water, filter and immerse the sections three or four hours. Wash well in distilled water and then soak for a short time in ordinary tap water to fix the color.

Transfer to methylated spirit or alcohol for ten or fifteen minutes to dehydrate. Take a small saucer or watch-glass full of clove oil and carefully float the section on the surface of the oil, and let it soak for five or ten minutes. When quite clear, wash in turpentine and mount in Canada balsam. The logwood solution may be used undiluted for quick staining, but better results are obtained by the slower process.

Mounting in Canada Balsam.—Take 4 ounces of dried Canada balsam and dissolve in 4 fluid ounces of benzole, filter, and keep in a good outside-capped bottle. Clean a slide, place some balsam on its centre, take the section from the turpentine with a lifter, and place it in the balsam on the slide. Now clean a cover-glass, and with a pair of forceps bring its edge in contact with the balsam on the slide; ease it down carefully so that no air bubbles may be enclosed, and press down until the section lies quite flat. Now put the slide away for a day or two so that the balsam may set, and then take a soft brush and with some benzole wash away the exuded balsam from round the edges of the cover. Allow the slide to dry and apply a good coat of gold size, and when this has dried, wash the slide with some soap and water; dry well with a soft cloth and add a coat of asphalt.

Double Staining. (Anilin Acid Green Stains.)—Take of acid green 2 grs., of distilled water 3 ozs., and glycerine 1 oz. Mix the water and glycerine well together, and dissolve the green in the mixture.

Carmine Stain.—(A) Of borax 10 grs., distilled water 1 oz., glycerine $\frac{1}{2}$ oz., alcohol $\frac{1}{2}$ oz. Dissolve the borax in water and add the glycerine and alcohol.

(B) Carmine 10 grs., liquor ammonia 20 mins., distilled water 30 mins. Dissolve the carmine in the ammonia in a test tube, with the aid of heat, if necessary, and add the water. Mix A and B together and filter.

Place the section in the green stain for five to ten minutes. Wash well in distilled water. Place in the carmine stain for ten to fifteen minutes, and wash in spirit in which the section must remain for at least ten minutes. Clear in clove oil and mount in Canada balsam.

Mounting Sections in Glycerine Jelly.—Place the section in distilled water and soak until all trace of alcohol is removed. Warm the jelly and place a few drops on the centre of a clean slide, and put the section in it. Clean a cover glass and apply it in the same way as directed for balsam. Allow the slide to cool, and then the exuded jelly may be scraped away with a penknife, and the slide washed with water. Dry well with a soft rag and apply a coat of gold size, and when this has dried, add another of asphalt.

The Life-History of Micro-Organisms, with its Relation to the Theory of Evolution.*

By ROBERT REYBURN, M. D.,

PROF. PHYSIOLOGY AND CLINICAL SURGERY IN HOWARD UNIVERSITY, WASHINGTON, D. C.

It is the distinguishing characteristic of a hitherto unknown law of nature, that it brings into harmony and order many isolated facts that before its discovery seemed to have no connection with each other. Such a law of nature, to the great majority of the scientists of the present day, the theory of evolution has seemed to be. There is a dazzling simplicity in this hypothesis of the genesis of all organic forms that is very attractive to the imagination. To believe that all living organized existences have been produced from a few masses or particles of living protoplasm, by the forces of natural selection and the conditions of their environment, is indeed solving the mystery of the universe as easily as a child, by the aid of the letters of the alphabet, masters the words of his mother-tongue.

But when in a spirit of calm and scientific inquiry we proceed to study these problems, we do not find them quite so easy of solution as the theory of evolution would seem to indicate. Difficulties and doubts arise that must be overcome before we can accept it.

The life-history of micro-organisms should throw light on these questions; many of them are composed of small particles of germinal matter, or protoplasm, without either the nuclei, cell walls, or cell contents, that are found in what are ordinarily known as cells in living organisms. Before our eyes and on the stages of our microscopes, we can study them to our hearts' content. We can watch them multiply either by the development of ova (or eggs), by gemmation (or budding), by fission (or division), or by the production of alternate or successive generations.

The first question to be answered concerning these microscopic organisms is the natural query, Whence came they? To this question evolution gives no answer.

Just as impassable as it was before the invention of the microscope is the yawning gulf that divides living protoplasm from dead matter. We can start on our argument to-day with the axiom, *Omnia vivum ex ovo* (every living thing has sprung from an egg or germ), with just as much assurance of its truth as when it was first enunciated by the great philosopher. Yea, even more so, for time and increased knowledge have only accumulated evidences of its truth.

When the biologist of to-day makes a pure culture of a living organism, and places it with the proper precautions, in a pure medium or soil fitted for its growth, he invariably finds, and expects to find, the same organism growing under his eyes, or on the stage of his microscope. He no more finds, or expects to find, a different organism resulting, than a horticulturist would find grapes growing upon an apple tree or thistles upon a plum tree. In regard to the theory of spontaneous generation, or the spontaneous formation of living organisms, from dead matter, it is only necessary here to say, that it is almost universally abandoned by all biologists of any eminence. This theory

* Read before the Washington Microscopical Society, April 8, 1890.

has been destroyed by the labors and investigations of many scientists, more especially by the elaborate and long continued experiments of Prof. Tyndall, of England.

Thousands of persons in various parts of the world find remunerative employment in putting up for table use meats, fish, fruits, and other perishable articles of food by what is known as the canning process. In this method of preserving food, the tin cans or other receptacles are placed in watery solutions of various salts, which boil at a temperature considerably above the temperature of boiling water; by being treated in this way the living germs in them become destroyed, and they become sterilized; whilst in this condition and whilst the steam is still escaping from the can, the opening is dexterously closed by a drop of solder. These cans all contain articles of food, which would be utterly destroyed and made putrid by exposure for a few days, or even hours, to the atmospheric air. The traveller in the arctic regions, or in the wilds of tropical Africa, if the cans are uninjured, expects to find the contents fit for table use, even when they have been kept for years.

Men who know nothing of science are willing to invest millions of money in the various industries concerned in the preservation of foods, with a firm faith that their capital is safely and profitably invested. This could not be the case if the spontaneous generation of the micro-organisms, which cause fermentation and putrefaction, were possible.

The life-history of micro-organisms when considered with regard to their rapidity of multiplication, presents a field of study which should give us valuable information with regard to the truth of the theory of evolution. It is very probable, and indeed very certain, that the study of a bacterium and its progeny for a few days gives us a series of generations more numerous than have existed among the higher classes of animals since the earth was fitted for their habitation. The rapidity of the growth and multiplication of bacteria is as far beyond the capacity of the human mind to conceive, as it is to attempt to measure the distances of the stars in the heavens, or to count their numbers.

Professor Buckner, of Germany, states the time usually required for one microbe or germ to become two, by the process of division, is fifteen minutes. At this rate it is computed that a single microbe would produce in twenty-four hours a million million million times the present human population of the earth. Professor Law, in a paper published recently in the *Pharmaceutical Era*, estimates that a single bacterium dividing and redividing would produce in forty-eight (48) hours, if undisturbed, 281,500,000,000, and in bulk would fill a half-pint measure, all produced in two days, from a single germ measuring the $\frac{1}{150000}$ part of an inch.

Pathological bacilli are just as numerous where found, and divide as rapidly. Professor Böllinger states that a cubic-centimeter (about one-fourth of a fluid drachm) of phthisical sputum (from a case of pulmonary consumption) contains from 810,000 to 960,000 tubercle bacilli. In an ordinarily copious expectoration the consumptive patient deposits nearly a million bacilli into his cup, and in an ordinary day he throws 30 or 40 millions of these micro-organisms into the world. Then, at a low estimate, ten thousand tuberculous patients, now living in New York city, daily expectorate some 300,000,000,000 tubercle bacilli.

If, as the theory of evolution presupposes, that there is really no such thing as a distinct species—a species being only a stepping-stone between a lower and a higher organism, in its upward progress of development—we should find in these minute organisms transitional forms shading into each other on every side. But as our knowledge becomes more complete of these organisms, we find that this is not the case. In fact, we find just as distinct morphological characteristics in the lower organisms as in the higher classes of animals. Over one hundred species of micro-organisms are now said to be known, which either cause or find their appropriate habitat in pathological conditions existing in man and the higher classes of animals. Many of these have been so thoroughly studied that we know their life-history just as accurately as we know that of the lion of Africa or the elephant of India.

When a biologist sows with proper precautions a pure culture of bacillus anthracis (The Bacillus of Anthrax or Charbon), does he ever get a progeny of bacillus tuberculosis? Or if he plants the germs of bacillus tuberculosis, does he ever produce the straphylococcus pyogenes aureus (or organism which causes the formation of pus)? Most assuredly not.

It is perfectly true that, by the microscope alone, it is difficult and sometimes impossible to distinguish between the different forms of micro-organisms. Each, however, can be identified in some way, either by its color, or form, or habitat, or method of growth. One micro-organism thrives in bouillon, another in gelatine, another in agar agar; one grows in small colonies of germs, another in single rows; some liquefy the gelatine or agar agar in which they grow, others do not. The more we study these minute organisms the more we are struck by their characteristic differences from each other. No more striking exemplification can be given of the value to mankind of scientific facts than is presented in the growth and development of the modern aseptic or, as it is often called, the Lister method of surgery.

The discoverer of the fact that certain minute organisms almost always found in the atmosphere, and which by their presence produce pus and septic poisoning, could scarcely have ever imagined the grand consequences and blessings to mankind that would result from it. By excluding from wounds and injuries these poisonous germs, surgery in our day has been completely transformed, and the gravest operations of surgery robbed of almost all of their terrors. One operator, Mr. Lawson Tait, of England, has operated for the removal of tumors from the abdomen over two thousand (2,000) times, and with a mortality that is steadily diminishing. In this last series of one thousand cases he reports an average mortality of $5\frac{3}{10}$ per cent.—in other words he has succeeded in saving from certain death nearly ninety-five (95) out of one hundred (100) persons operated upon by him. This whole superstructure of modern surgery is built upon the laws controlling the growth of micro-organisms, and their unchanging methods of development.

Probably the most beneficent gift that the science of medicine ever gave to mankind was Dr. Jenner's great discovery of vaccination as a preventative of small-pox. During past centuries small-pox spared no rank or station in society, from the monarch in his kingly robes, to the beggar in his rags; all felt the power and virulence of this dread de-

stroyer. This deadly and fearful scourge has been destroyed by the growth on the surface of the human body of a micro-organism found in the vaccine virus. During the two hundred and twenty (220) years that have elapsed since Jenner's discovery, how many millions upon millions of men upon this earth have been vaccinated, and with precisely the same result! Has the micro-organism of the vaccine virus changed its appearance during that time, or altered in its power for good? Not a particle.

We plant this germ in the arm of a child, and on the third or fourth day we see on the place a vesicle (or little blister) arise filled with a clear, watery fluid, this afterwards becomes milky and then yellow in color; coincident with this, the vesicle or pustule becomes changed in shape, it becomes what is called umbilicated, or depressed in the centre of its upper surface. These special changes in shape and growth distinguish the vaccine pustule from an ordinary pimple or sore. Every case of vaccination with pure vaccine virus passes through this life-history just as perfectly as it did in the days of Jenner, and, so far as we can judge from the past, will do so till the end of time.

But we can go still farther back in time for illustrations of the perpetuity of micro-organisms. Early in the world's history some of the earlier races of mankind were in the habit of performing a rough method of trephining by scraping with the sharpened edges of shells or flints the skulls of certain persons. These skulls show attempts at repair, and also in some a carious or necrosed condition of the surrounding bones; in others, bones of the body have been fractured and repaired in just the same way as if the injuries had been inflicted in our day.

As the same phenomena attended the injuries and repair of these skulls and other bones as are found to-day, is it not logical to assume the existence at that remote period of the same micro-organisms that cause these conditions now? But we can go still farther back in this matter; some of the earlier remains of fossil fishes show injuries of bones with repair, and can we not fairly make the same assumption for them? If this be indeed so, it would make the life-history of some micro-organisms so ancient as to render the time that man has lived upon the earth insignificant by comparison.

To recapitulate, the following statements seem to be true:

1. Micro-organisms have their life-history and morphological characteristics just as definitely as the higher organisms.
2. Micro-organisms retain their individuality of species, and do not change into each other.

If the above statements shall prove to be true, they seem to be incompatible with the truth of the theory of evolution.

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Sterilization of Water by the Chamberland Filter.—M. L. Dor finds, as the result of several experiments, that Chamberland's filter may be confidently relied on for removing bacteria, for by means of it the author has succeeded in rendering the water perfectly free from germs.—*Lyon Medical*.

Respiration of Entozoic Worms.—Herr G. Bunge has found that various species of *Ascaris* will live from two to seven days in a medium entirely free from oxygen.—*Rev. Biol. du Nord de la France*.

The Condition of Variation.

By F. BLANCHARD, M. D.,

WASHINGTON, D. C.

It is the purpose of this article to note some conditions under which species show variation, with particular reference to pathogenic micro-organisms.

With all our recent advancement, our knowledge of pathogenic microbes is still rudimentary.

It is unwise to make positive assertions concerning them or their functions, to say more than, it is possible, or it is probable.

Let us then go no farther than to say that, in view of certain familiar facts, it is probable that pathogenic microbes do undergo such changes on account of change of environment, that, if the altered conditions were continued for an indefinite period, the change might amount to specific variation.

But note well the condition of change, a change of environment. The advocates of the perpetuity of species too often forget this prime condition of variation.

There seems to be no reason why a given species, identical conditions being present, may not continue its characteristic features for ages. The micro-organism of vaccinia is often cited as an example of such persistence. But why has not its character changed? Simply because its environment has not changed. Every precaution has been taken to prevent a change. Its culture medium has been the living blood of heifers and men. It seems safe to predict that when experimenters, who, stimulated by adequate prizes, are now trying to find a safe culture medium for the vaccine virus outside of living bodies, when they have ransacked all possible culture media, they will be able to show a wide degree of variation in the hitherto unvarying vaccine virus.

Several observations upon other microbes, noted in the present number of this periodical, render this statement justifiable. The primal requisite of all variation is change of environment; and in this case no change of environment has ever been attempted until now.

Experimenters have found it very difficult to induce a true diphtheria in the lower animals by introducing into their blood cultures of the supposed diphtheritic germ.

The poisoned animal dies, but rarely is a pseudo-membrane developed on its mucous surfaces.

The change of medium has produced a modification in the manifestation of the germ's pathogenic power.

It is probable that many prominent symptoms of a given disease are produced, not directly by the presence of myriads of its particular microbe, but by a ptomaine or leucomaine, a by-product of microbic growth. It seems almost certain that the relative amount of this by-product must vary greatly in different epidemics of the same disease. Else why the variation in the intensity of the symptoms? In one epidemic of scarlatina the symptoms are so mild that the little patients seem hardly sick at all. In another epidemic there is such rapid evolution of some toxic agent that rugged children die before the characteristic eruption appears.

Every druggist knows that the *Digitalis purpurea* of our gardens contains a much less proportion of digitaline than that grown in the wild state. Is it not possible that the specific bacillus of a given disease may, under conditions not yet understood, likewise vary its product of leucomaine? Or, to extend still further the shaky platform of possibility, may we not in time rear a digitalis that will not contain digitaline, and a *Bacillus anthracis* that will not in its life-history evolve anthracine?

It seems improbable that a plant consisting of a single cell is less susceptible to variation than is an elaborate organism like Indian corn; yet the gross differentia between the Indian corn grown in New England and that grown in Kansas are greater in degree than the differences that characterize species in many genera—the genus *Carex*, for example.

Under changed environment, the wild boar, which produced only brawn and bristles, has been transformed into the domestic hog, which produces only fat. It is hard to believe that a microbe would not, under equal change of conditions, show equal variation in form or product.

An Interesting Experiment with the Microscope.

BY PROF. W. F. DURAND,

AGRICULTURAL COLLEGE, MICH.

The following experiment, though not, perhaps, pertaining to microscopy in the strictest sense of the term, is, however, so beautiful and so simple that no one having a microscope should fail of trying it.

Before describing the nature of the experiment, it may be well to refer briefly to the structure of the retina of the eye. This, as is well known, consists in general of an expansion of the optic nerve over the back of the eye between the choroid coat and the vitreous humor. Its structure is very complex, being divided by different writers into from four to ten separate layers. On the anterior or inner surface, a little to the outer side of the centre, is a yellow patch, within which is a well marked depression. This yellow patch is called the *macula lutea*, and the depression the *fovea centralis*. The *macula lutea* is the most sensitive portion of the retina, and the *fovea centralis* is the part whereon rests the image of an object directly looked at. That is, if the eye directly looks at an object, its image is formed on this depression of the *macula lutea*. It is, therefore, that part of the retina which does, so to speak, nearly all the work. The fibres of the *macula lutea* have the direction of rays diverging in all directions from the centre of the *fovea centralis*. One of the layers of the retina is that of the rods and cones, as they are called. The rods are long cylindrical bodies packed in closely with their axes at right angles to the plane of the retina. The cones are somewhat conical or bottle-shaped bodies, interspersed among the rods. In the *fovea centralis* the cones alone are found. These bodies—the rods and cones—are supposed to receive the vibratory influence of the rays of light. This is then transmitted to nerve cells connected with the filamentary expansion of the optic nerve.

Ramifying through all parts of the retina except the *fovea centralis* is a capillary network of veins and arteries. This network, together

with the radiating fibres of the *fovea centralis*, may be rendered visible by the experiment in question.

To proceed then with the details, take a microscope with the objective and ocular in place, and the mirror or condenser so adjusted as to give a moderately illuminated uniform field. Then grasp the microscope by the standard and look steadily at the field, at the same time shaking the microscope back and forth through a distance of perhaps one-tenth to one-eighth of an inch. The motion may be right and left or to and from the observer, or in any other convenient direction, but in any case it will be seen that the portion of the network which is thus made apparent consists of vessels running in a direction nearly at right angles with the direction of the motion. That is, not all of the network can be seen at the same instant, though a good idea may be obtained of it from these successive glimpses.

The same general effect may be produced by keeping the microscope still and shaking or nodding the head. In fact, the conditions necessary for the manifestation of this vascular net-work are, 1st. A uniform field from which the rays converge to a focus and then diverge to the eye so that the focus really serves as a very small source of light for the eye. 2d. A relative motion between the eye and this focus or field.

In appearance the net-work is dark on a light ground, no coloration being apparent. The manifestation is, in fact, the shadow of the vascular net-work thrown on the sensitive layer of the retina. In ordinary vision the pupil is filled with light and measurements of the diameters of the pupil and retinal vessels, and of the distance between the pupil and the vessels, and between the vessels and the sensitive layer, show that under such circumstances no distinct shadow is possible. The cone of the umbra falls within this layer, and, therefore, it is affected by the penumbra only, and this effect is not noticeable. With the smaller source of light, however, the cone of the umbra becomes much longer and reaches the sensitive layer, producing there well-defined shadows of the vascular net-work. The difference between the light and shade is, however, not great, and due to the well-known law of the decay of nervous excitement, the parts exposed to the light soon lose their greater excitation and the field again appears uniformly illuminated. We do not, therefore, observe this appearance when looking steadily at the field of the microscope, or when there is no relative motion between the field and the eye. If the head or field is moved, however, bringing about such relative motion, the shadow will fall on another part of the sensitive layer, a part which is relatively fatigued. As long as this condition lasts, the shadow will become apparent, dark on a light field. Quickly, however, the parts screened by the shadow gain in sensitiveness while the others lose, and the field again appears uniform. A continual succession of short, quick movements will give, therefore, a continual succession of glimpses of this vascular shadow, giving in their entirety a very good idea of its structure.

It is also true that when the shadow is suddenly shifted the parts before screened are as suddenly exposed to the full illumination. These shaded parts are relatively supersensitive, and, therefore, as the full illumination falls on them they will be more effected than the surrounding parts, and, therefore, the vessels will be outlined in light on a dark field. Usually this effect is not as well marked as the other, so that as

above stated the appearance is usually that of a dark net-work on a light field, though with some observers both may be seen, or possibly the latter may be the more prominent.

Such, in brief, seems to be the explanation of the manifestation of this vascular net-work.

There are other methods of rendering this apparent, but as they do not involve the use of a microscope, they need not here be mentioned.

This experiment has always seemed to the writer to be an exceedingly interesting one. Nothing could be simpler, yet it enables us to gain a glimpse of the minute structure of our own retina, a feat we should be inclined to believe exceedingly difficult.

MEDICAL MICROSCOPY.

BY DR. F. BLANCHARD,

WASHINGTON, D. C.

Artificial Cultivation of Ringworm Fungus.—Dr. H. L. Roberts, in the *British Journal of Dermatology*, 1889, p. 359, records his observations upon *Trichophyton tonsurans* under cultivation. The culture medium used was saccharine infusion of malt and alkalized beef-broth incubated at 30° C.

The fungus began its development in 24 hours, and in three or four days from the formation of the primary colony secondary deposits were visible. If the colonies rose to the surface, they speedily became covered with a white powder. On microscopical examination the mycelium was found to be regularly septate and filled with a granular protoplasm. When development takes place in air, the mycelium becomes finer, the segments are small, and the terminal fruit-bearing filament may end in an ampulla. The spores are pear-shaped, are attached by their narrow end, and are sometimes seen to project from the ampullæ.

Inoculation experiments on guinea pigs, and on the author's own arm, gave the usual characteristics of ringworm.

The author concludes that *Trichophyton* is "a fungus able to vary its form and activity according to the physical and chemical properties of the soil on which it grows." As a saccharine medium has been found to be the most favorable soil, it follows that the animal skin is unsuitable; hence, "the ringworm fungus vegetates, but does not develop" there.

Pathology of Chorea.—Dr. E. D. Fisher recently read a paper before the New York Neurological Society upon this obscure subject. Among the lesions noted were a temporary increase of connective tissue in the brain in rheumatic cases, blood extravasations, embolism, thrombosis, and dilatation of the smaller vessels.

In chronic chorea these conditions have caused degeneration and a fine general sclerosis of the brain.

Transformation of Microbes.—M. A. Chauveau has continued his researches on the limits, conditions, and consequences of the variability of *Bacillus anthracis*. He finds that this bacillus may exhibit three types, the respective properties of which appear to have been definitely acquired.

(1) The bacillus brought to the bottom of the scale of descending variation, non-virulent, but still with vaccinal properties.

(2) The bacillus partially revived by ascending variations, and again capable of killing an adult guinea pig, and even a rabbit, but ineffective towards ruminants, as horses, though highly vaccinal towards them.

(3) The bacillus whose revivification has been rendered complete, that is, is mortal to the sheep. This type is probably still only vaccinal to the cow or the horse.

It will be remembered that the non-virulent bacilli were obtained by cultivations brought into contact with compressed oxygen. To restore the virulence it is necessary to add blood to the cultivation in contact with greatly rarified air.—*Comptes Rendus*, 1889, p. 597.

Sources of Puerperal Wound Infection.—A paper with the above title was read before the Kings County Medical Society December 17, 1889, and is published in the *Brooklyn Medical Journal* for April, 1890, p. 212. We abstract some deductions and practical points. The old question of the identity of the streptococcus of pus, puerperal fever, and erysipelas is discussed, and the weight of quoted authority and experiment seems in favor of identity, though it may be that various microbes are competent to produce the symptoms of puerperal fever. So called auto-infection from germs in the normal vaginal secretions is denied. The symptoms may be induced, or simulated, by ptomaines inhaled in sewer gas; but symptoms so caused quickly subside on removal of the cause.

The practical point is that *infection comes from without*. Whatever the pathogenetic agent, it is introduced in the patient's blood by the non-sterilized hand of the attendant or nurse coming in contact with an abrasion on the cervix or vaginal wall. Thus in 427 confinements in the Dresden clinic, in which no vaginal examinations and no irrigations were made, only $1\frac{6}{10}$ per cent. ever had a temperature above the normal.

We have long thought that the vaginal injections, as administered by the average monthly nurse, are much more dangerous than useful, and this confirms our view.

Now let us reduce examinations during labor to the minimum, and, when obliged to make an examination, make our hands thoroughly aseptic, and we may hope for a great reduction in the number of cases of puerperal fever.

Technical Methods for the Central Nervous System.—In the same number of the same journal is a paper by E. H. Wilson, M. D., read before the Brooklyn Medical Microscopical Society, December 4, 1889. Space will not permit quotation; but it is of special value because it collates the tried and approved methods of Golgi, Weigert, Grenacher, Fleschsig, Freud, and Upson for staining sections of the central nervous system, and omits methods tried and rejected.

Plasmodium Malariae.—According to the *Medical News*, the Vienna bacteriologists have settled that malaria is caused by *Plasmodium malariae*. It takes up its abode in the red blood corpuscle. At first it is only one-fifth the size of the corpuscle, but as it grows it entirely fills the corpuscle, and then breaks up into a number of daughter cells that repeat the process of growth and division. The use of quinine

diminishes the number of the organisms very markedly, and in case of cure they can no longer be found. They are more numerous just before the chill, and just after it are hard to find, for then the division has taken place and the small cells escape observation.

The Bacillus of Diphtheria.—During an epidemic of diphtheria in the village of Horn, in 1889, bacteriological studies of the pseudomembranes were made in seven cases by Sprouck, Doets, and Wintgens. In each case they found the bacillus described by Klebs in 1883, but were unable to find the spores described by Babès. Cultures inoculated in the trachea of rabbits and guinea pigs produced true diphtheria. The toxic agent producing nephritis and paralysis appeared to be a chemical substance produced by the bacilli.—*La Sem. Med.*

EDITORIAL.

F. Blanchard, M. D.—It is with much pleasure that we announce Dr. Blanchard's removal to Washington, D. C. After practising ten years in his native State, he comes to this city of scientists as well as of public officials to practise medicine and microscopy, as well as to pursue his favorite study of botany, where a new and varied flora charms him at every turn.

Dr. Blanchard has contributed the Notes on Medical Microscopy to this periodical during the past two years. He will not only continue this, but be more intimately associated with us in the editorial management. He has already been appointed to a position in the Census Office, where his medical knowledge will be of much value, so that his, as well as our, MICROSCOPICAL JOURNAL work has to be done in odd hours, evenings, etc. On this account our correspondents will indulge us if we are not always so prompt as desirable in answering letters, of which a great number reach us upon all imaginable subjects. Dr. Blanchard's botanical reputation is world-wide, and he will be cordially welcomed to this city by the botanists as well as by the microscopists.

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Slides Received.—We desire to return thanks to the donor of the following interesting slide: Sundry diatoms, prepared by A. F. Bartges, Esq., Akron, Ohio.

NOTES.

Preservation of Desmids.—Mr. W. H. Walmsley, in the *English Journal of Microscopy*, says: "Having been perfectly successful in preserving the color in many of our fresh-water algæ, it may be that the same method would prove successful with desmids. My plan is simply to have a wide-mouthed bottle, with glass stopper, filled with distilled water, in which I have a number of pieces of camphor. When it is desired to mount the algæ, I place a portion of the same in some of this camphorated water, to which a few drops of glycerine have been added, in a watch-glass. At first it will become lemon yel-

low, but after a few hours the original green returns in its full vividness, then I at once mount in a shallow cell with a portion of fluid."

Penicillium Glaucum and Corrosive Sublimate.—In the *Botanical Gazette*, March, 1890, John M. Coulter reports observing a rank growth of *Penicillium glaucum* on flour paste, which contained about one part in 900 of corrosive sublimate.

Oidium Albicans.—MM. Linossier and G. Roux state (*Comptes Rendus*, 1889, p. 752) that this fungus under cultivation takes on varied forms according to the nature of the nourishment. Thus if a small quantity of saccharose be present in the liquid, short mycelial filaments will be found to exist, these filaments becoming longer as the quantity of sugar increases.

The character of the fungus varies similarly if glycerine or mannite be present, or if the nourishment consist only of a simple ammoniacal salt. Finally, if the fungus has been cultivated for several generations in a medium where it affects the globular-filamentous form, it more easily takes this form when transported to new media.

Microscopy at the Paris Exhibition.—The *Annales de Micrographie* has concluded (1890, pp. 168-171) a series of brief articles on the microscopic display at the Paris Exhibition of 1889. This record is very complete, and will doubtless prove a valuable contribution to this branch of science.

A Powerful Objective.—Dr. Van Heurck announces in the *Journal de Micrographie* that Zeiss, working from the formulæ of Professor Abbe, has succeeded in producing a $\frac{1}{10}$ inch "apochromatic" objective with an aperture of 1.63, and so constructed that under suitable conditions the whole of this aperture can be utilized. The author states that with this objective he has resolved the entire frustule of *Amphipleura pellucida*, not merely into lines, but into pearls as distinct as he has ever seen on *Pleurosigma angulatum*. Repeated measurements show these pearls to be arranged in lines separated longitudinally by $\frac{1}{5000}$ part of a millimeter, while the transverse striations are separated by the $\frac{1}{3000}$ of a millimeter (about 0.00001 and 0.000014 inch respectively). Three of the new glasses have been made at a cost of \$2,000 each.

MICROSCOPICAL SOCIETIES.

ESSEX CO., N. J.—F. VANDERPOOL, Sec'y.

March 20.—Residence of Mr. G. S. Woolman, Orange, N. J. Subject, Mounting Media. Rev. Mr. Mann, who has done a large amount of work in mounting diatoms, gave to the Society his experience with various media. First, in speaking of glycerine mounts, he said that he had never had one of these fail, and he attributed his good fortune to the employment of what he called "successful cells." By these he meant cells made in some such way as the following: Take a good lacquer like King's red lacquer, ring a number of cells and put them away for several months to dry and harden. When ready to make a

glycerine mount, take one of these slides, run a fresh ring over the old and hard one, fill with glycerine (containing the specimen), press down the cover, wipe off the excess of glycerine, ring again, and set aside to dry.

Another mounting material which could be used with this kind of a cell is carbolized water, which is made by adding to a few ounces of pure water a very small amount, say one-quarter or one-eighth of a drop, of a saturated solution of crystallized carbolic acid in water.

Another medium for mounting was discovered by Mr. Mann accidentally. He had a mount of the buffalo moth and had ringed the cell with Brown's rubber cement. Unfortunately, in one sense, but fortunately, in another, the cement ran in upon the specimen, when, to Mr. Mann's surprise, the portions touched by the cement appeared to better advantage than the rest of the object.

In mounting diatoms, he very seldom uses balsam, as there are other media which are better and easier to handle. Among these are styrax and tolu. These, as they are purchased in the stores, need to be purified. Styrax can be purified with benzole. Tolu also, which contains the troublesome (because crystallizable) cinnamic acid, can be purified with the same material, which in the cold dissolves cinnamic acid, but not the pure tolu.

The purified tolu is then poured upon a sheet of glass to allow the benzole adhering to it to evaporate, and afterwards dissolved in chloroform and filtered. When mounting with this medium there is no trouble with air-bubbles; it seems to be impossible for one to remain under the cover. The mount must be ringed, however, for if not the tolu will creep. Mr. M. uses Brown's rubber cement rubbed up with a little Prussian blue to give it a color.

Mono-bromide of naphthalene has a high index, but it is hard to confine. A good cement for this mount is Stratena, which is afterwards covered with gold size or shellac.

To illustrate the difference between the appearance of a diatom mounted in balsam and another in mono-bromide, Mr. Mann exhibited two slides of *Surirella cardinalis* mounted in these media. The superiority of the mono-bromide mount was seen at once.

Brightwellia pulchra was then exhibited, mounted in balsam and also in tolu, and the latter shown to be much superior.

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ST. LOUIS CLUB OF MICROSCOPISTS.—E. J. Nitzschmann, *Sec'y*.

May 6, 1890.—The regular meeting of the Society was held at the College of Pharmacy, and proved a very interesting one. President Falk occupied the chair. Mr. C. C. Faris read a paper on Oil of Turpentine used in Microscopy, and the Method of Rectification. Prof. Whelpley gave the result of his examination of lycopodium for adulterants, but found all of the specimens to be pure.

Prof. Whelpley also read a paper on The Best and Simplest Methods for Cleaning and Repairing Old Mounts.

The following slides were donated to the cabinet: *Blatta orientalis*, by Mr. Goodman; Ossicles from ear of rabbit and rat, by E. J. Nitzschmann; *Cannabis indica* and section of locust's wing, by C. C. Faris.

SAN FRANCISCO, CAL.—WM. E. LOY, *Sec'y.*

Wednesday, April 23, 1890.—A number of accessions to the library were reported, including the "Journal of the Liverpool Microscopical Society." A communication from Professor Hanks was read, which stated that on the 4th of June, 1870, the San Francisco Microscopical Society was organized. It was deemed advisable to make the 20th anniversary one of special interest, and the President appointed a Committee of Arrangements.

A communication on the subject of a new flash-light for photographing was read by the Secretary. This was a memorandum from the proceedings of the Washington Chemical Society before which Dr. Thomas Taylor, of the Department of Agriculture, made the exhibition of his new discovery, which, it is believed, will supersede several now in use for photographing at night. The composition consists largely of charcoal made from the silky down of the milk weed—a form of carbon which he prefers to all others, because of its freedom from ash. A few grains being placed on tissue paper and ignited by a punk match, produced a prompt and blinding flash, while it was observed that the paper on which the powder rested was not even scorched, thus demonstrating the greater security from accidents. Mr. Breckenfeld thought it probable that this new discovery would prove of value in photographing infusoria and other living minute organisms with the aid of the microscope.

The event of the evening was the exhibition of a splendid series of photo-micrographs and appropriate remarks by E. W. Runyon. The speaker described his method of procedure in detail, and to further illustrate his topic had his apparatus on exhibition. For the purpose he used his Bulloch stand, the tube in a horizontal position, the eyepiece entering a camera made especially for the purpose. The tube should be lined with velvet, or blackened, and in focussing a hand-magnifying glass was used behind the ground glass, to secure sharp definition. All the photo-micrographs exhibited by Mr. Runyon were made at night with oil light.

The addition to a sensitive film of certain coloring matters, which are known as optical sensitizers or selective sensitizers, renders the film sensitive to rays which would otherwise produce little or no photographic effect. This discovery was made by Vogel in 1873. The rays to which the film is thus made sensitive are rays which it would not absorb under ordinary conditions, but which it can absorb after treatment with the dye. The dyes used are of the eosin group. Eosin sensitizes for green and yellowish green, and erythrosin for yellowish green and greenish yellow. For photographing many microscopic preparations, such as stained sections of animal and vegetable tissues, the orthochromatic plates had given excellent results.

With a 3-inch objective, the exposure, even with the light of a student lamp only, should be very brief—practically instantaneous; with a $\frac{1}{4}$ or $\frac{1}{5}$ -inch objective, a longer exposure must be had, the duration of which would depend largely on the nature of the object to be photographed. Particular attention was directed to the photo-micrograph of a vertical section of the human scalp, showing with great clearness the hair follicles, fat cells, glands, etc.; and as examples of fine details the head of horse-fly, proboscis of blow-fly, and arranged diatoms.

The assistance of photography in the investigation of minute structure is of great importance, as it reduces more nearly to a mathematical plane the portion viewed. It also confirms the results obtained in the resolution of difficult tests. With some experience one can finish four or five negatives in an evening. Such expedition ought to satisfy the most exacting.

BOOK NOTICES.

Catalogue of the Scientific Publishing Company. 16°, 108 pp. 27 Park Place, New York. 1890.

This is a very handy and classified catalogue of scientific and technical books for the use of those desiring to select works on the following branches of science: Chemistry, assaying, engineering, physics, mechanics, metallurgy, and mining. An index of authors is also given.

Catalogue, 1890. Ginn & Co.

We are in receipt of the catalogue for the present year of this well-known firm, which contains a full list of the late publications of that house, together with the introduction prices. A careful perusal of its pages will well repay those desirous of keeping abreast of the literature of the day, and especially teachers, who will find much to interest them in the outlines of new text-books. The catalogue will be sent on application to all interested in literature.

Heroic Ballads. Edited by D. H. Montgomery. 12°, 319 pp. Ginn & Co., Boston. 1890. (Price, 50c.)

This volume is made up of a series of selected ballads, with careful analyses and copious critical comments. As the book is intended principally for school use, the selections are given in most cases without abridgment, and where omissions do occur it is with the view of better adapting the work to the school-room. The convenient foot-notes on each page serve as an excellent exposition of the general ideas pervading the different ballads, a feature which should meet with popular approval. The book is supplemented by an index to notes and also by an index to authors.

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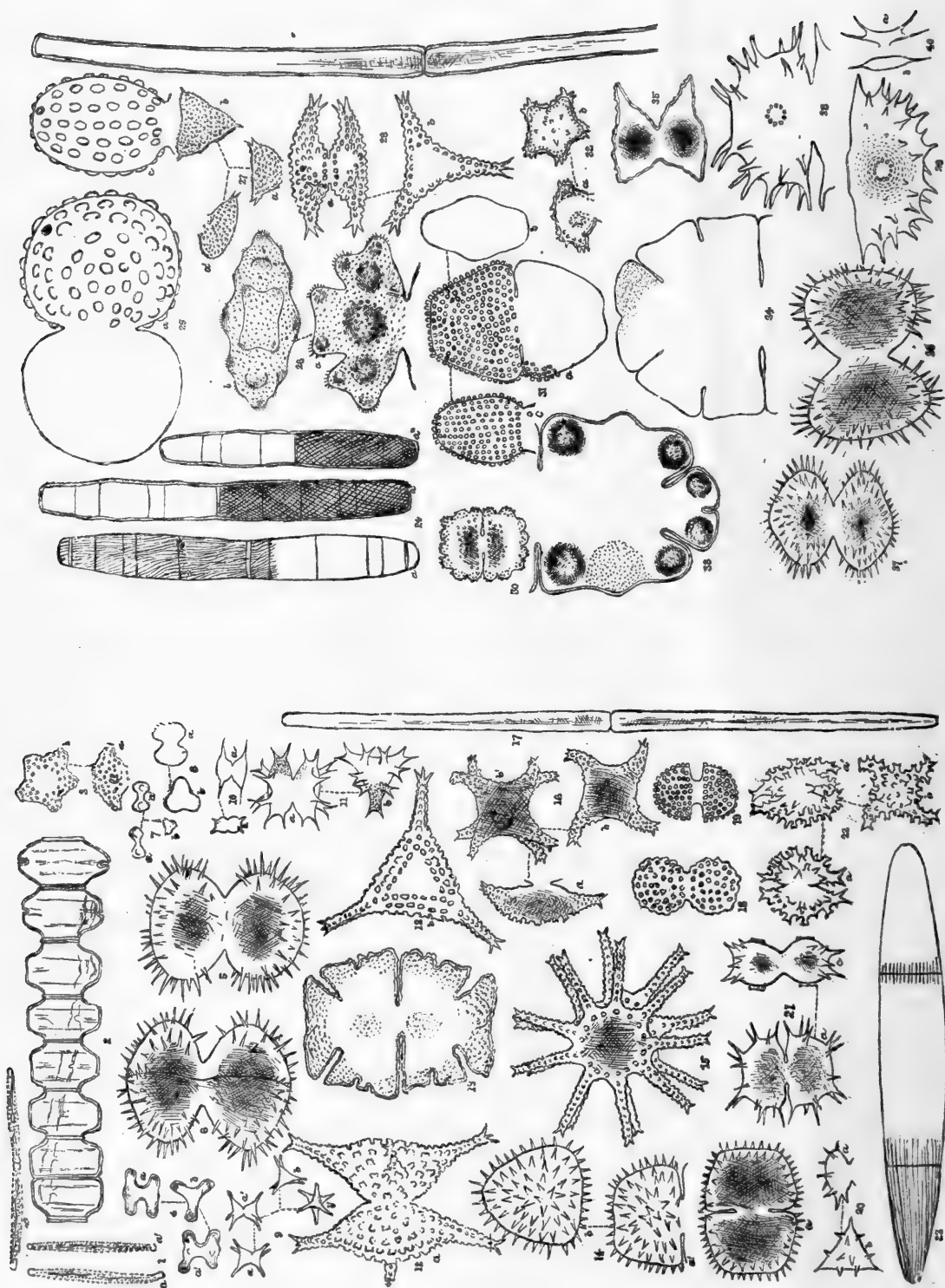
[These notices will be given six insertions in this column at 25 cents per line or fraction thereof.
FOR EXCHANGE.—Slides of selected diatoms. D. B. WARD, Poughkeepsie, N. Y.

WANTED.—Unmounted microscopical material, also micrographic dictionary. Will exchange or buy. CHARLES VON EIFF, 124 Clinton Place, New York City.

WANTED.—A clean copy of Rev. William Smith's British Diatoms, and Schmidt's Atlas of the Diatomaceæ. JAMES B. SHEARER, Bay City, Mich.

OFFERED.—Diatomaceous Earth from Utah (Desert) for Histological Mounts. PROF. ORSON HOWARD, Salt Lake City, Utah.

CORRESPONDENCE invited with a view to the exchange of either mounted or unmounted Oribatida (British) for American species. E. BOSTOCK, Stone, Staffordshire.



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European subscriptions may be sent directly to the above address accompanied by International Postal Order for \$1.15 per annum, or they may be sent to Messrs. Trübner & Co., 57 Ludgate Hill, London, or to Mr. W. P. Collins, 157 Great Portland street, London, accompanied by the yearly price of five shillings.

Some Newly-Described Desmids.

[WITH ONE PLATE.]

In the June number of the *Journal of the Royal Microscopical Society* is a paper by Prof. Wm. West, of the Technical College, Bradford, giving a list of fresh-water Algæ from North Wales. From it are extracted the descriptions of new species and varieties of desmids, as follows:

Fig. 1.—*Gonatozygon minutum*, nov. sp. (G. cellulis subcylindricis, apicem versus angustatis, utroque polo constrictis, vicies longius quam latum, cytodermate dense subgranulato.)

About twenty times as long as broad, slightly swollen towards the middle and constricted under the apices, cytoderm densely but slightly granulate.

Fig. 2.—*Desmidium coarctatum* Nord, var. *cambricum*, nov. var. (Var. cellulis brevioribus et apicibus latoribus.)

This chiefly differs from the type in the cells being shorter and having broader apices. This variety is somewhat doubtfully placed under this species, which it seems to connect with *Desmidium cylindricum* Grev., the shape of the cells in front view being nearer the latter, but the breadth of the apices bringing it nearer the former. The side view shows the apices to be only about half the thickness of the cells, corresponding in this respect with *D. coarctatum* Nord, with which it also agrees in having the constriction reduced to a mere retuseness in the side view.

Fig. 3.—*Staurostrum margaritaceum* Meneg., var. *coronulatum* nov. var. (Var. cum annulo granulorum parvorum ad apices truncatos semicellularum.)

This has the apices of the semicells truncate and bordered by a circle of small granules.

Fig. 4.—*Staurostrum bacillare* Bréb. (Long 17-18 μ .)

Figs. 5 and 36.—*Staurastrum cumbricum*, nov. sp. (*S. magnum*, tertiam partem longius quam latum, semicellulis late ellipticis, a vertice triangulare; lateribus leviter convexis cum spinis velatis sed paucis ad sinum, multis longioribus ad angulos.)

Fronde rather large, one-third longer than broad, semicells broadly elliptical, end view triangular, with slightly convex sides, beset with spines except at the constricted part, many of which are much longer about the apices of the angles.

Fig. 6.—*Staurastrum cumbricum*. var. *cambricum*, nov. var. (Var. semicellulis subangularibus et isthmo angustiori.)

This differs from the type by having the semicells somewhat angular, and the isthmus narrower.

Fig. 7.—*Staurastrum osteonum* nov. sp. (*S. minutum*, sinu latissimo et obtuso, semicellulis rotundato-ellipticis, a vertice triangulare, angulis rotundatis et lateribus concavis.)

Minute, front view shaped like a dumb-bell, end view trigonal with slightly concave sides, cytoderm smooth.

Fig. 8.—*Staurastrum coarctatum* Bréb., var. *subcurtum* Nord.

Fig. 9.—*Staurastrum iotanum* Wolle.

This tiny species may easily escape observation. Its arms are similar to those of *St. tetracerum* Ralfs, but much finer and more delicate, the end view being also triradiate. Its form in front view is not unlike those of *St. O'Mearii* Arch., and *St. pterosporum* Lund., but it is smaller, and has arms and not spines.

Fig. 10.—*Arthrodesmus tenuissimus* Arch.

This being a rare species a figure is given here.

Fig. 11.—*Staurastrum furcatum* Ehrb. A faintly punctate variety of this species is shown in the figure. The lateral bifid processes are almost reduced to two spines, the other "bifid processes" being sharply bispinate.

Fig. 12.—As the figures of *Staurastrum anatinum* Cooke & Wills, as published by Cooke differ so greatly, a figure of the form which was abundantly seen at Capel Curig, is given. Cooke's figure in *Grevillea* is nearer the form herein figured than the one in his *British Desmids*. The extremities of the processes often appear as in Fig. 12*d*, caused by the spines being placed somewhat vertically over each other.

Fig. 13.—*Micrasterias americana* Ehrb., var. *Lewisiana* nov. var. (Var. lobis polaribus subintegris et latioribus, incisuris angustioribus infra lobos polares.)

This has the end lobes subentire and wider, the infra-apical incisions are narrower also than in the var. *recta* Wolle, which it approaches. This is a very distinct variety, and very distant from "forma *major* Reinsch," with which it is worth comparing, as this latter seems to be at the other extreme.

Fig. 14.—*Staurastrum muricatum* Bréb., var. *acutum* nov. var. (Var. spinis brevibus (nec granulis), semicellulis truncato-pyramidalis.)

This differs from the type in the acute though short spines in place of "conic granules," as well as in the trapezoid or truncately pyramidal semicells.

Fig. 15.—*Staurastrum ophiura* Lund., forma *nonaradiata* (Forma a vertice nonaradiata.) End view with nine rays.

Of this beautiful species, two forms were noticed along with the type. One, a nine-rayed form, was seen several times; the other, a very long and slender-armed one, measured 145 μ across the arms. Cooke and Wolle describe the end view as 7 (rarely 6 or 8) rayed; the forms from Capel Curig are almost all 8-rayed.

Fig. 16.—*Staurastrum cyrtocentrum* Bréb., forma *tetragona*. (Forma a vertice tetragona.)

Fig. 17.—*Docidium elongatum* nov. sp. (D. quadragies longius quam latum, ad utrumque polum sensim attenuatum, apicibus truncatis, medio non inflato.)

Frond about forty times as long as broad, the straight sides gradually tapering from the uninflated base of each semicell to the truncate apex.

Fig. 18.—*Cosmarium orbiculatum* Ralfs. The figure is given merely for comparison with Fig. 19.

Fig. 19.—*Cosmarium isthmium* nov. sp.

This form is the same as *C. excavatum* Nord, var. *duplo-major* Lund., as described and figured by Wolle. As the author does not believe this species to be a variety of *C. excavatum*, he proposes the above name. A. W. Bennett, however, does not adopt the name, but believes the form identical with *C. orbiculatum*, the width of the isthmus being merely an indication of early stage of division.

Fig. 20.—*Staurastrum spiniferum* nov. sp. (S. parvum, semicellulis ellipticis cum octo spinis (circa) ad marginem semicellulæ singulæ, a vertice triangulare cum spinis novem, lateribus leviter concavis.)

Segments elliptic, with about eight spines in the periphery of each segment; end view triangular, sides very slightly concave, showing two spines between each apical one.

Fig. 21.—*Xanthidium cristatum* Bréb. var. *spinuliferum* nov. var. (Var. cum quattuor vel quinque spinis parvioribus additis inæqualiter ordinatis intra marginem semicellulæ singulæ.)

This has four or five additional spines, rather unequally disposed just within the margin of the front view of each semicell.

Fig. 22.—*Staurastrum controversum* Bréb. The figure is given in order to show a variety of this variable species.

Fig. 23.—*Closterium striolatum* Ehrb., forma *recta*. (Non curvata, rectissima.)

This differs from the type in having no curvature; several examples were seen, and were turned over and over.

Fig. 24.—*Penium spirostriolatum* Bark. As this species appears to vary in different localities, some figures are given. This variability has been noticed from Maine, N. Ireland, Scandale in the lake district, and Glen Shee and Craig and Lochan in Scotland. The *parallel striæ* can often be seen on both the upper and under surfaces of the empty cylindrical frond, and then they appear as if they crossed each other.

Fig. 25.—*Cosmarium tetraophthalmum* var. *subrotundum* nov. var. Newborough Warren. (Var. sinu apertissimo semicellulis subrotundis facto.)

This differs from the type in the open sinus caused by the subrotund semicells.

Fig. 26.—*Euastrum verrucosum* Ehrb. This is a variety with more gaping sinus than usual and a subrectangular polar lobe.

Fig. 27.—*Staurostrum denticulatum* Arch.

Fig. 28.—*Staurostrum dubium* nov. sp. (*S. submagnum*, latius quam longum, scabro-granulatum, semicellulis fusiformibus, constrictione, profunda, radiis productis tricuspidatis et inflexis, a vertice triangulare, ad basem semicellulæ cum annulo singulo granulorum.)

This species is nearly twice as broad as long, deeply constricted with rough granules, processes inflexed, granulate and tricuspidate, semicells somewhat fusiform, base annularly granulate, vertical view triangular.

This will no doubt prove a controversial species; it is near *S. manfeldtii* Delp., but smaller and with thicker processes; it is also more regularly granulate.

It also comes near *S. pseudosebaldi* Wille, but lacks the basal inflation and the bifurcate spines.

Fig. 29.—*Docidium*. The species has not been determined satisfactorily.

Fig. 30.—*Cosmarium cælatum* Ralfs, var. *hexagonum* nov. var. (Var. cellulis hexagonis, apicibus truncatis tetracrenatis, granulis centralibus in seriebus linearibus ordinatis.)

This differs from the semiorbicular type in having a distinctly hexagonal form, bearing four of the crenatures of each semicell at the truncate ends; the central granules are also arranged in linear series not concentric.

Fig. 31.—*Cosmarium controversum* nov. sp. (*C. medium*, granulatum, midian partem circa longius quam latum, sinu anguste lineari, semicellulis truncato-pyramidalis, granulis concentricè ordinatis, a vertice subtruncato-ellipticis elevatione centrali lata, a latere obtuso-ovatis.)

Frond granulate, about one-half longer than broad, sinus deep and linea, semicells truncately pyramidal, end view elliptic with a broad elevation at each side, side view obtusely ovate, granules arranged somewhat concentrically.

Fig. 32.—*Staurostrum margaritaceum* Meneg. A form from Capel Curig which shows short spines irregularly disposed at the apices.

Fig. 33.—*Euastrum crassum* Ktz. A form of this species was frequent which had a marked protuberance about half way up the side of the front view of each semicell.

Fig. 34.—*Micrasterias jenneri* Ralfs, var. *simplex* nov. var. (Var. lobis quinque semicellulæ leviter concavis et incisuris brevioribus.)

This chiefly differs from the type by having each of the five lobes of the semicell but slightly concave, and the incision not so deep.

Fig. 35.—*Staurostrum proboscideum* var. *subglabrum* nov. var. (Var. margine undulato nec spinis truncatis vestitis, radii apicibus integris.)

This differs from the type in being undulately rough and not adorned with truncate spines, as well as in the entire apices of the processes.

Fig. 36.—See description of Fig. 5.

Fig. 37.—*Staurostrum cumbricum* var. *cambricum* nov. var., forma minor.

It differs from *St. Pringsheimii* Reinsch in its larger size, and in its relatively sharper spines of varying lengths. It differs from *St. senticosum* Delponte in being longer than broad, whereas the latter is broader than long, and also has its long spines more uniformly arranged. *St.*

notarisii Delponte differs in having its uniform spines regularly arranged as well as in its narrower sinus. *St. saxonicum* Buln differs in its relatively broader isthmus and its shorter uniform spines.

Fig. 38.—*Xanthidium brébissonii* Ralfs. This form differs from that usually seen.

Fig. 39.—*Xanthidium aculeatum* Ehrb.

A peculiar form of this is figured which some may think belongs to another species by reason of the shape of the basal angles of the semi-cells, still the spines are scattered in the same way as those of the species under which it is placed.

Fig. 40.—*Arthrodesmus octocornis* Ehrb.

A variety with wide and short cells.

Staining and Permanent Preservation of Histological Elements Isolated by Means of Caustic Potash or Nitric Acid.*

By S. H. AND S. P. GAGE,

ITHACA, N. Y.

“Properly chosen isolating reagents in the hand of a histologist form the best kind of a knife.” Two of the most efficient of these are caustic potash and nitric acid. They dissolve or soften intercellular substance and act more quickly on connective tissue than on cell cement. They serve for isolating glandular elements, like gastric glands, etc., or by prolonged action for isolating individual elements. If the action is unchecked, both agents finally destroy all the cellular elements also.

CAUSTIC POTASH (POTASSIUM HYDRATE, KOH).

1. Weak solutions destroy or dissolve all soft organic structures with great rapidity.

2. Strong solutions (30 to 50 per cent., also saturated solutions in water) act with great rapidity on intercellular substances, and quite slowly on the cellular or structural elements, so that they may be isolated and studied in their natural forms and relations.

3. By the addition of water, glycerine, or alcohol to the caustic potash upon the elements the solution is simply weakened, when it rapidly dissolves all the elements.

4. The action of the strong solution may be checked at any time (*a*) most satisfactorily by displacing it with a 60 per cent. solution of potassium acetate, or (*b*) by the addition of sufficient glacial acetic acid to neutralize the caustic potash and form acetate of potash. After the action of the caustic potash is checked, the elements may be preserved indefinitely *en masse* in a 60 per cent. solution of acetate of potash, or after being treated with a saturated solution of alum in 40 per cent. alcohol or glycerine.

5. A 30 to 50 per cent. aqueous solution—preferably a 35 to 40 per cent. solution (caustic potash in sticks, 35 or 40 grams, water 55 or 60 c.c.)—may be used for the isolation of the structural elements after hardening the tissues with alcohol, chromic acid, or a chromium salt, picric acid, etc. It requires a longer time for the isolation of hardened

* Abstracted from proceedings of the American Society of Microscopists, 1889, p. 34.

than of fresh tissue, and the results are not so satisfactory. The elements of almost any tissue may be successfully isolated by means of strong solutions of caustic potash, but it has been most successfully employed in the study of the epidermal and muscular tissues, especially the elements of cardiac and smooth muscular tissue.

6. When fresh tissues are employed it is especially necessary that they be perfectly fresh, and that, if from organs like the heart, where a great deal of blood is present, the blood should be washed away with water before the application of the reagent, as the strong caustic potash preserves the blood corpuscles, and their presence is detrimental to the clearness of the outline of the elements.

7. Only small pieces of tissue should be used (if the tissue is massive the pieces should not exceed half a cubic centimeter), and about fifteen to twenty times as much potash solution should be used as tissue.

8. After ten to fifteen minutes the tissue should be tested with dissecting needles every five minutes, in order not to prolong the action unnecessarily.

9. As soon as the elements separate readily, the caustic potash is poured off and a plentiful supply of a 60 per cent. solution of acetate of potash added (potassium acetate 60 grams, water 40 c.c.). This displaces the caustic potash and checks its action. The efficiency and rapidity of the action of the acetate is increased by the addition of 1 per cent. of glacial acetic acid to it.

10. After the caustic potash has been removed the elements may be mounted for the microscope in 60 per cent. acetate of potash, in glycerine or in glycerine jelly.

11. Staining and mounting the isolated elements: After the caustic potash has been displaced the acetate of potash is removed, and a plentiful supply of a saturated aqueous solution of alum is added and allowed to remain for a considerable time, preferably twenty-four hours or more. The elements then stain very satisfactorily with hæmatoxylin or alum carmine. Other stains may also be successfully used. After staining, the elements may be mounted by any of the approved methods—in glycerine, glycerine jelly (which is perhaps the best), Farrant's solution, or Canada balsam. After the use of the alum water, the elements may be preserved *en masse* in 40 per cent. glycerine or 40 per cent. alcohol, stained and mounted whenever desired.

If the preparation is left in acetate of potash for a day or more, the cells stain well with alum carmine, or hæmatoxylin without using the alum water. It is necessary, however, to wash away the acetate quickly with water, or simply to absorb it, otherwise there will be a multitude of crystals in the preparation. The use of alum water for the cardiac muscles of the frog is not so successful as with those of mammals. Staining directly from the acetate is quite successful.

NITRIC ACID (ACIDUM NITRICUM, HNO_3).

1. Nitric acid in various degrees of concentration has been used for the isolation of the structural elements by many different histologists, but it is due to Paulsen that a 20 per cent. solution (strong nitric acid 20 c.c., water 80 c.c.) came into general use; and while it serves fairly well for many of the tissues, its greatest applicability is to the isolation of the structural elements of muscular tissue, especially the ordinary

striated or skeletal muscle and smooth or unstriated muscular tissue. For the cardiac muscular tissue, caustic potash is greatly superior.

2. As just stated, a 20 per cent. solution of nitric acid has been found the best isolating agent for the fibres of striated muscle. Perfectly fresh tissues are preferable, and in fact necessary for obtaining the best results, especially in separating the fibres their whole length. If the tissue is not fresh the fibres become fragile and cannot be isolated throughout their whole extent.

3. In order that the fibres may remain straight, the muscle should be suspended in the acid with its natural attachments if possible. When that is impracticable the muscle should be extended on a piece of cork and pinned in position with vaselined pins. The vaseline prevents the corrosion of the pins.

4. If the object is to isolate fibres throughout their whole length, the fat and connective tissue on the surface should be removed either before the immersion in the acid or as soon as the acid has sufficiently softened the connective tissue so that it may be removed without too much dragging upon the specimen. When the fibres can be separated easily the action is sufficient. The time varies according to the temperature. At the ordinary temperature of a living room, from one to three days is sufficient for almost any muscle. If the connective tissue is very dense the time may be increased. By using heat the action may be completed in a few minutes, but it is not so satisfactory, as the surface layers are too much, and the interior layers too little, affected.

5. When the action is sufficient the muscle is transferred to water to remove the acid. It is well to change the water several times.

6. If it is desired to study the fibres with reference to their form, length, and relations, the manipulation should be as little as possible. A fascicle is chosen which frays easily with a coarse sewing needle. It is transferred to a slide with a drop of water, or if a yellow color is desired, a drop of glycerine tinged with picric acid. The fibres are then carefully separated with coarse needles under a dissecting microscope. The excess of glycerine is removed with blotting paper, and a drop of warm glycerine jelly is allowed to spread slowly over the preparation. The fibres are arranged with needles and the slide allowed to cool until the glycerine jelly has a glutinous consistency. It is then covered with a warm cover. The partly-cooled glycerine jelly prevents the fibres from becoming entangled when the cover is put on.

7. If the nuclei are to be especially studied, the muscle remains in water until all the acid is removed. Then it is stained in Koch's tubercle stain, diluted four or five times with water, for twelve hours or more. A fascicle is then removed to a slide with 20 per cent. alcohol, containing sufficient picric acid to make it a lemon-yellow color. This is gradually replaced by 50 per cent., and then by 95 per cent. alcohol. In the last the fibres are separated as described above, and after draining away the alcohol, clove oil collodion is added and the fibres finally arranged. As soon as sufficient evaporation has taken place to fix the fibres, a cover-glass is coated with Canada balsam and placed upon the specimen. If the result is successful the nuclei are stained a brilliant red and the body of the fibre yellow. The transverse striæ are always very sharp and clearly defined after picric acid staining.

8. If it is not convenient to study the specimen at once, or if it is a

large one, like the œsophagus, and is to be studied for a considerable time, the action of the acid may be checked by transferring the specimen from water to a saturated aqueous solution of alum. In this the specimen may remain for several days, or even two weeks, in a cool place without marked deterioration. The fibres are treated as under 6, or the fibres may be stained quite successfully with hæmatoxylin, and may then be mounted in any way desired.

9. If one cares only for the general structure of a muscular fibre, not caring for the length and relations, as in ordinary laboratory work, the muscle should be prepared as above in 4 and 5, washed with water, when the fibres separate easily, then transfer to a saturated solution of alum and allow to remain a day or two more. Then the fibres may be successfully stained with aqueous hæmatoxylin, mounted in glycerine, glycerine jelly, or Canada balsam, etc. If it is desired to preserve for future use a large amount of this dissociated material, it may be placed in 40 per cent. glycerine or 40 per cent. alcohol from the alum water, and stained and mounted at any time; or the fibres may be shaken in a bottle of alum water till they are separated, then stained with hæmatoxylin and preserved *en masse* in 40 per cent. glycerine. This is a very convenient method for a large laboratory. Then a small amount of the dissociated material can be given to students as they are ready for it, and they can mount the fibres in glycerine jelly or in balsam.

10. For muscular fibre cells (smooth and unstriated muscle) the muscular coat of the stomach, or any other organ composed mostly of muscular fibre cells, may be placed in the 20 per cent. nitric acid till the intercellular connective tissue and cell cement are sufficiently softened to allow the cells to be shaken apart. The acid is then washed away with water. Alum solution is added, in which the cells are shaken apart. After twenty-four hours or more the alum is poured off and the cells stained with hæmatoxylin or alum carmine. After washing away the staining fluid with water the cells may be mounted in glycerine or glycerine jelly.

The Business Woman's Journal.—In this journal for June are two new departments. One of these, in the interest of teachers, is edited by Mrs. May Wright Sewall, of Indianapolis. This lady in her first editorial gives the public to understand that the *Business Woman's Journal* intends to make a strong fight for the payment to women teachers of salaries equal to those which are received by men. The other new department is under the editorial management of Mrs. Estelle M. H. Merrill ("Jean Kincaid" of the *Boston Globe*), and is to be devoted to the interests of journalists. In the article entitled "Women in Journalism," Mrs. Merrill criticises very severely the articles published in the daily papers under the departments devoted to the interests of women.

White's Objects.—Many of them are worth five to ten times their cost.—H. L. Tolman, Chicago, Ill.

I am greatly pleased with them. How you can afford to sell them at such a marvellously low price is a mystery to me. I shall gladly recommend them.—G. H. Hicks, Owassa, Mich.

The Use of the Simple Microscope in Pharmacy.

BY H. M. WHELPLEY, M. D., PH. G.

That the microscope is a valuable aid to the pharmacist in the discharge of his duties is no longer a question of doubt. The fact that all the leading colleges of pharmacy have special departments for teaching how to manipulate the microscope is sufficient evidence that it is one of the essentials in a well-regulated drug store.

The important question and the one which interests the average druggist is the selection of a suitable instrument and the learning how to use it to the greatest advantage. To the making of different styles of microscopes (like the publication of books) there is no end. Up to the present time, however, there is no microscope especially designed for the use of pharmacists. We have instruments for physicians, special ones for chemists, for mineralogists, and for botanists, as well as those for the examination of writing, such as signatures, etc. Fabric makers have microscopes so arranged that they can readily count the number of threads to a given space. Instruments have been devised for class demonstrations and others for the entertainment of the laity, while the celebrated Griffith Club Microscope is so arranged that it is readily portable, and one can always have a first-class instrument with him without the inconvenience of handling the ordinary patterns which are unhandy when it comes to travelling. There is a microscope for the special purpose of examining skin diseases, while another instrument is arranged to inspect the contents of an aquarium. We have trichoscopes for the detection of trichina spiralis in pork. But no one has gotten up a microscope which is essentially a druggist's instrument. The demands of pharmacy do not call for a pattern which shall materially differ from all others. More than one instrument has been advertised as being "specially adapted to the use of pharmacists," but the same instruments are also "specially adapted to the use of physicians," and are in reality only ordinary microscopes.

The microscope enables us to see objects which we cannot perceive with the unaided eye. In doing so it enables us to see either very small objects or very small portions of large ones. On account of this power of the microscope to bring us close to the objects some one has proposed to call it an engiscope, a word which signifies to see at a short distance, but the new term has not met with a hearty reception.

All microscopes, whether great or small, plain or complicated, are divided into two classes. This division is made on purely optical grounds. Microscopes are either simple or compound. A simple microscope is one with which we look directly at the object and see it in its normal position (provided it is not distorted in view on account of the microscope being a very poor one). A simple microscope may consist of one or any number of lenses, but when there are more than one we look through all of them directly at the object. As an illustration we may look at a stigma of Spanish saffron under a simple microscope and the cleft end of the stigma will appear in the same position that it actually occupies.

A simple microscope may be very simple in its parts or may contain a complication of apparatus equal in complexity to some of the patent suppository moulds.

A compound microscope on the other hand is always made up of two or more simple microscopes, so arranged that the magnified image formed by one simple microscope is viewed by another similar microscope or else a second magnified image is formed with the second simple microscope, and this in turn viewed by a third simple microscope. When a compound microscope is made up of but two simple microscopes, which is by far the more common kind, the object viewed is not seen in its normal position but is reversed. In the case of the Spanish saffron stigma, the cleft end if at the right, would appear to be to the left. It is simply turned around. A drop of a liquid running down an incline would appear to crawl up hill in spite of the force of gravity. Thus it will be readily seen that it is more difficult to manipulate objects under a compound microscope than it is under a simple instrument. By the use of an erector, which is another simple microscope, the image can be again inverted so that it will appear in its normal position. This is usually done when compound microscopes are employed as dissecting instruments.

Fortunately for the pharmacist, the simple microscope is of great service in his business, although I regret to state that it is not employed to the extent it should be. There are several forms of the simple microscope on the market. Among the most serviceable are what an Englishman has termed the platyscopic lenses. They come with three separate lenses which magnify fifteen, twenty, and thirty diameters respectively. Simpler-looking microscopes are made in this country but do not magnify as much as these do. These English microscopes are what are known as achromatic triplets. If these cannot be procured then purchase one of the cheaper simple microscopes, set in rubber or tortoise shell (the rubber frame is the more serviceable) and make use of them. They are generally known as pocket magnifiers and the lens closes into the frame like a knife blade into the handle. If single ones are procured, get at least two, one with a power of fifteen diameters and the other twenty or twenty-five diameters. I find a triplet which has three lenses in one case to be very convenient.

It is by no means difficult to determine at least approximately the magnifying power of a simple microscope. It is found in the case of one lens by measuring the focal distance and dividing it by ten. The focal distance is the distance of the lens from the object so that it can be readily seen. Thus if the focal distance is one inch we divide ten by one and get ten as the number of diameters the lens magnifies. If the distance is but one-half inch then ten divided by one-half gives twenty as the magnifying power expressed in diameters. Another method which is based on the same principle is to focus some infinitely distant object as the sun and then measure the distance of the lens from the surface on which the sun is focussed and divide it into ten as in the former case. When more than one lens is used their combined power is equal to the sum of their individual powers. Thus a set of lenses with powers of ten, fifteen, and twenty diameters respectively will when combined equal forty-five diameters, and magnify the same as a single lens of that power. In this connection it may be well to state that whenever two or more lenses are used as a simple microscope the highest power or strongest lens should always be turned toward the object.

A New Method for Studying the Elements and Tissues of Warm-Blooded Animals at their Physiological Temperature.*

BY PROF. L. RANVIER,

MEMBRE DE L'INSTITUT, PARIS.

The method consists in plunging the microscope and the preparation to be examined into a vessel of water warmed to 36° – 39° C.

The microscope should be of simple construction, and, of course, an immersion objective is required. The object to be studied is carefully imbedded in paraffine, so that the water cannot penetrate to it. Examine, and select the interesting point as in an ordinary microscopic examination.

Warm the objective in dry air to about 40° C. Without this precaution, a mist, more or less dense, will form on the surface of the lenses.

By the side of the microscope on the work-table, place a glass vessel containing distilled water warmed to 40° C. It is necessary to use distilled water because undistilled water when heated deposits calcareous matter.

Place the microscope in the water, having the slide only one half or one centimetre beneath the surface. A thermometer should be placed in the water. The contact of the water with the sides of the containing vessel and with the microscope will lower its temperature 2 or 3 degrees, *i. e.*, to about the temperature of living animals. For observations lasting more than 8 or 10 minutes, it is necessary to add sufficient hot water to keep the temperature at 37° or 38° C. For brief observations this is not necessary.

If bubbles arise between the lens and the cover-glass, they may be removed with a pencil.

By these simple means the author has been able to make more observations in a month than in twenty years with the old apparatus, among them, for example, watching the division of lymphatic cells in mammals.

I intend to review, complete, and extend these observations. Meanwhile I wish to communicate a fact in general biology which appears of some importance.

We know that in mammals dead for twenty-four hours, the tissues no longer present physiological reactions. Nevertheless, anatomical elements separated from the animal before death are still living in 24 hours, as I have demonstrated by the following experiment:

From a rabbit killed by decapitation I have taken a drop of peritoneal lymph, by means of a pipette sterilized by heat, placed it in a portable humid chamber, and covering it with paraffine, have kept it in the laboratory at a temperature of 10° or 15° C. for 24 hours. Then, raising the temperature to 38° by means of the above described hot bath, I have seen great numbers of lymphatic cells throw out amœboid prolongations and thereby move about.

Before raising their temperature to the point necessary for their vital reactions, these cells were spherical and immobile. They were then in a condition of latent life, a sort of hibernation; but after 24 hours they revive, on the application of the proper degree of heat.

*Translated in abstract from the *Journal de Micrographie* for April, 1890, by F. Blanchard, M. D.

The Student Microtome.

By BAUSCH & LOMB,

ROCHESTER, N. Y.

This useful piece of apparatus is shown in the frontispiece of the June number. On account of the character of the work done on these instruments, lacquered brass is not suited to them. They are made of iron, as far as practical, nicely finished by japanning, while brass is used for the delicate parts, and highly polished and nickel-plated.

The base, curved arm, upright and V-shaped beds are made of one continuous casting, thus insuring rigidity without excessive weight. The knife carrying-block is fitted in the angular way in such a manner that the knife moves steadily through it without deviating from its plane and without requiring any extra pressure. Stop-screws with soft rubber cushions are fastened at the ends of the way, which serve to overcome any sudden concussion, and thus prevent a vibration of the knife. The upper surface of the block is provided on its entire length with a grooved slot, to which is fitted a sliding thumb-screw, so that the knife may be fastened at any point upon it.

To the carriage are directly fitted the micrometer screw with graduated disk and a slide which is acted upon by the former. A provision is made for taking up the possible wear on the screw. At one side of the carriage a spring is attached which works in the grooves on the edge of the disk with a pronounced click, so that the feed may be controlled without watching it; this may be loosened so that it will not act when it is desired to use the index only. A nickel-plated drip-pan is countersunk in the upper surface of the bed, and is easily removable for the purpose of cleaning.

The feed-screw attachment is placed at one end of the bed, and for all ordinary work the best position of clamp is as shown in the cut. For serial sections it may be swung on its axis to the middle of the bed and fastened in this position.

The dimensions are as follows:

Length of bed,	-	-	-	-	-	-	6 inches.
Total height,	-	-	-	-	-	-	4 "
Limit of adjustment by micrometer screw,	-	-	-	-	-	-	$\frac{1}{2}$ "
Limit of adjustment by clamp,	-	-	-	-	-	-	1 "
Diameter of graduated disk,	-	-	-	-	-	-	$1\frac{3}{8}$ "
Pitch of screw,	-	-	-	-	-	-	$\frac{1}{50}$ "
Length of cutting edge of knife,	-	-	-	-	-	-	$3\frac{1}{4}$ "

The Mississippi Valley Medical Association will hold its 16th annual session at Louisville, Ky., Oct. 8, 9, 10, 1890. The medical profession is cordially invited to attend, and papers are earnestly solicited. Titles should be sent to the secretary, Dr. E. S. McKee, 57 W. 7th St., Cincinnati. The social and intellectual features of the occasion promise to be very great. An additional feature will be the annual session of the American Rhinological Association, which convenes at the same place Oct. 6, 7, 8, 1890. The secretary is Dr. R. S. Knodé, Omaha, Nebraska, who will be glad to receive titles of papers.

Detection of Arsenic by the Microscope.

By E. A. GIBBS,

WASHINGTON, D. C.

Arsenic (arsenious oxide) or "white arsenic" presents a characteristic octahedral or derivative of octahedral crystal, varying from $\frac{1}{250}$ to $\frac{1}{5000}$ of an inch in diameter. The powder found in the shops is composed of either an amorphous mass or of crystals, hence the microscopical character of the powder, whether crystalline or not, the relative proportion of crystalline to amorphous matter and the prevailing size of crystals or lumps may, in some instances, enable us to determine with considerable certainty whether or not a sample was obtained from a given source. It has been found by certain observers that great uniformity generally exists among samples of powder taken from the same source.

The crystals of arsenious oxide are readily obtained by volatilizing metallic As in a free supply of air. In cases of arsenical poisoning, owing to the difficult solubility of arsenic, white particles may be found in vomited matter or adhering to the walls of the stomach and intestines. These should be carefully picked out, washed, and dried, and then introduced into a reduction tube. A small piece of charcoal is placed above; then heat applied first to the charcoal until red hot. Then hold the whole end of the tube in the flame. The arsenic will be reduced to the metallic state and deposited a little further up the tube. Shake out the remains of the charcoal and heat the metallic ring when it will volatilize, and, combining with the oxygen of the air, be deposited in the form of a white ring composed of minute octahedral crystals.

For liquids, freed from organic matter, the "Marsh process" appears to be the most certain. The action of this test depends on the decomposition of the soluble compounds of arsenic by nascent hydrogen and the formation of arseniureted hydrogen, which when decomposed by heat yields a deposit of metallic arsenic on the cool portion of the tube. When a portion of this sublimate is heated in a tube the deposit of crystals occurs. It is said that $\frac{1}{100000}$ gr. of As_2O_3 in 1.000000 of water yields quite a good sublimate.

Fallacies of this test are, first, presence of As. in reagents Zn and H_2SO_4 , which must be determined beforehand. Presence of antimony in the suspected substance, which also yields a metallic stain by the Marsh process. But the stain will be found on both sides of the heated tube, owing to the fact that antimonureted hydrogen is decomposed at a lower temperature. Arsenic is only found in advance of heat. In a tube, arsenic when heated, decomposes readily, and recondenses a little further on in crystalline form. Antimony requires a much higher temperature, but also deposits sometimes in octahedral crystals. The identity of these crystals can readily be established by chemical tests. Where both are present advantage may be taken of the use of a bath of olive oil, which boils at about 600°F .; arsenic volatilizing completely between 400° and 500°F . and antimony requiring a much higher temperature.

Reinsch's process is another method. The suspected substance being dissolved in distilled water, to which about $\frac{1}{6}$ of its volume of HCl has

been added, and a slip of copper coil introduced, the arsenic will be deposited as an iron-grey coating. Remove the slip, wash well with water (alcohol and ether if any fatty matter is present), and gently heat in a tube when the characteristic crystals will again be produced. Copper and tube must be well dried. Cautions in this test are, not to employ too large surface of copper and not to remove the copper from the solution too soon.

When examined with $\frac{1}{4}$ -inch objective these crystals can be seen and recognized by their shape up to $\frac{1}{10000}$ of an inch in diameter. Other substances will yield a deposit on copper, viz: Antimony, Bismuth, and Mercury. The volatility of the arsenic and the character of the crystal will settle the question.

Brief History of the San Francisco Microscopical Society.

BY HENRY G. HANKS,

SAN FRANCISCO, CAL.

The San Francisco Microscopical Society originated in the Academy of Sciences. Hiram G. Bloomer and Henry G. Hanks, both active members of that society, realizing the importance of the use of the microscope in their especial studies, botany and geology, proposed forming a microscopical section of the academy. The plan not according with the views of other members, it was decided to form a new and independent society. A number of meetings were held at 649 Clay street, and on the evening of June 4, 1870, the San Francisco Microscopical Society was organized, a constitution and by-laws adopted, and officers elected.

The officers for the first year were: J. B. Trask, M. D., President; Gregory Yale, Vice-President; Henry C. Hyde, Recording Secretary; Henry G. Hanks, Corresponding Secretary, and Emile Neustadt, Treasurer. Henry C. Hyde and Henry G. Hanks are still members of the society.

For want of funds and for other reasons no considerable advance was made. Having no adequate apparatus, interest after a few months began to wane, and before the expiration of a year meetings were discontinued and the society practically ceased to exist. There were some members who were not discouraged, and comparing views and discussing the causes which lead to dissolution, resolved on a new organization, and the result was the present society.

The proceedings of the original society have not been preserved. An event transpired during its existence worthy of record, which is remembered with pleasure by the older members. Early in 1871 Joseph Beck, the eminent London optician, visited San Francisco for the first time, and March 14 he gave a reception to the members at the Cosmopolitan Hotel. On this occasion he exhibited a magnificent binocular microscope of aluminium, with all accessories complete. Besides the rare and interesting objects brought with him, he showed others from the society's collection, among which were individual gold crystals from Owen's Valley, metacinnabarite (then recently discovered), silicified wood, platinum, and diamond sands from the coast of Oregon. The exhibition was a revelation to the society, and the fledglings who

had acquired a small stock of scientific terms and could glibly prattle of apparatus they had never seen, maintained discreet silence.

The reorganization of the society took place April 5, 1872, and it then consisted of fifteen members. The officers elected were as follows: Henry G. Hanks, President; A. B. Stout, M. D., Vice-President; C. Mason Kinne, Recording Secretary; Henry C. Hyde, Corresponding Secretary, and D. P. Belknap, Treasurer. The remaining members who assisted in the organization were Charles H. Denison, James Stratton, J. H. Hill, George A. Treadwell, James Murphy, M. D., Melville Atwood, H. J. Holmes, G. Kustel, D. Vandenberg, and Charles G. Ewing. The first scientific paper read before the society was "On the Scale Insect," by C. Mason Kinne. The society was incorporated under the laws of the State of California August 30, 1872.

Good work was accomplished during 1872, and there was much enthusiasm. The large microscope and accessories were purchased at a cost of \$1,500. The first mineralogical paper was read by Guido Kustel (on a peculiar form of silver mineral), and the society, having gained some notoriety, received its first visit from a representative of the press at its meeting on November 1.

At the meeting held September 18, 1873, a donation of seaweeds with diatoms attached was received, and this was the first time diatoms were mentioned in any of the meetings. This is an event worthy of mention, because the members of the society afterward took an active interest in the study of diatoms, and the cabinet is very rich in diatom preparations. Three years later, August 3, 1876, the famous Santa Monica deposit of diatomaceous earth was first brought to the notice of the society, and so rich in new species did this small find prove, that specialists and learned societies from all parts of the world eagerly sought a small quantity for study.

This paper being entirely historical of the society's proceedings, covers briefly the twenty years of its existence; its life has been an active one. There have been read at its meetings, by eminent specialists, papers of great value on all subjects pertaining to microscopy. Its work has been recognized and appreciated by kindred societies in America and abroad, especially by the Royal Microscopical Society of London. It is the intention of the society to publish its history and proceedings at an early day, including some of the valuable papers read at its meetings.

MEDICAL MICROSCOPY.

By F. BLANCHARD, M. D.,

WASHINGTON, D. C.

Disease Germs.—The June number of the *Brooklyn Medical Journal* contains the remainder of Dr. J. G. Johnson's vigorous paper on "Disease Germs and Disinfectants." We are inclined to accept his conclusion that the causative microbe of scarlatina is the bacillus described by Jamieson and Eddington, of Edinburgh. His experiments seem vigorously conducted and the results decisive. He claims wonderful results from the disinfectant treatment of scarlatina, painting the

tonsils and washing the surface of the body with a solution of corrosive sublimate, 1 to 1,000. Since the bacillus requires an alkaline medium, he also uses as a gargle vegetable acids, lemon juice, or cider vinegar. By these means desquamation is reduced to a minimum and albuminuria and rheumatism are avoided. His remarks upon the disinfection of the sick-room are also in pace with the most advanced thought of the age. He proves the inutility of sulphur fumigation, and gives to boiling water, flowing steam, and corrosive sublimate their true first rank as disinfectants. Dr. Johnson writes with the courage of conviction.

Typhoid Bacilli in Celery.—Dr. Charles M. Cresson, of Philadelphia, states that he has more than once found the typhoid bacilli in the juice that he has squeezed out of celery grown near Philadelphia.—*Annals of Hygiene*.

Experiments have recently been made to ascertain the destructive power of gastric juice upon bacteria. After six hours *Bacillus tuberculosis* retained sufficient vitality to produce general tuberculosis. After eighteen hours the microbes had either died or lost their virulence. Typhoid bacteria died in two to three hours, and the bacilli of cholera in two hours. Dilute hydrochloric acid produced similar results, indicating that it is to the hydrochloric acid of the gastric juice that its antiseptic properties are due.

BIOLOGICAL NOTES.

Bacteria in Hail-stones.—The *Johns Hopkins Hospital Bulletin* for May, 1890, records some observations by A. C. Abbott upon the bacteria found in the interior of large hail-stones which fell during the storm of April 26, 1890. Care was taken to exclude all organisms except those brought down from the altitude where the hail was formed. The number of organisms observed ranged from 400 to 700 to the cubic centimetre. The majority represented only a single species, a short, thin, oval bacillus; though several other undetermined species were observed.

These observations suggest possibilities. Medical men are often asked, with a sneer, to account for the origin of sporadic cases of a disease well known to be contagious, scarlatina, for example, where the source of infection is impossible to trace.

A cyclone may have swept through an infected region; clouds of dust containing the bacillus of the disease in question may have been carried to a height, borne along for hundreds of miles, encapsuled in hail-stones or rain-drops, and brought again to earth in a location favorable to their growth.

Peach Blight on California Buckeye.—A fungus practically indistinguishable from the peach blight, *Ascomyces deformans*, has several times within the past few years been observed on leaves and twigs of the buckeye, *Æsculus Californica*. Further observations are desirable.—*H. W. Harkness in Zoe, May, 1890*.

BACTERIOLOGY.

BY V. A. MOORE, M. D.

WASHINGTON, D. C.

Methods of Staining Spores.*—The spores of bacteria were first observed and described, but not rightly understood, by Perty in 1852. Then Pasteur made a sharp distinction between the biology of an organism and its spore without quite solving the question morphologically. Cohn was the first to describe biologically and morphologically the formation and germination of spores. Further peculiarities were observed by Koch, Brefeld, Buchner, and especially Prazmowski, who clearly described the different forms of the germination of spores.

The spores in the unstained condition appear, especially in the hanging-drop, as strongly refracting round or oval bodies either within the less refractive bacteria, or free near these. Sometimes they are situated near the middle, sometimes at the end. The cells in which they appear are sometimes unaltered, sometimes peculiarly swollen. Since condensed bacteria-protoplasm, according to Prazmowski, strongly refracts light, it is to be concluded that a body still more strongly light-refracting is to be regarded as a spore.

Here belong, together with the foregoing morphological changes which regularly appear under certain biological conditions in spores, their great resistance to chemical agents, and especially to high temperature, and the fact that in the use of watery or dilute alcoholic solutions they are not stained, but appear as unstained refracting spaces within the stained bacteria.

An accidental observation showed how the spores could also be brought to view stained. Koch saw, in staining the tubercle bacilli with aniline-water-methyl-blue, that the spores of a species of large bacteria were stained blue at the same time, while the bacteria themselves were stained brown by the subsequent treatment. Gaffky was not able to stain the spores of other bacteria in the same manner. On the contrary, Neisser succeeded in staining the spores red and the bacilli blue when he used warm aniline-water-fuchsin and subsequently stained with methyl-blue. Buchner discovered a means for the isolated staining of spores. Because the staining of the living bacteria was not successful, but those killed by drying and heating were readily colored, Buchner thought that the reason the spores were not stained was because of the greater resistance of the spore membrane. He endeavored, therefore, to destroy the membrane of the spores of the bacillus subtilis, and thus make them accessible to the staining fluid. In this manner he succeeded in staining spores in dried cover-glass preparations which had been heated from one-half to one hour at a temperature of 210° C. in a dry-oven or one hour in a steam-kettle at 120° C. A successful result was also obtained when the preparations were dipped in concentrated English sulphuric acid for fifteen seconds, and afterward carefully washed, or when they were subjected for a longer time to a concentrated solution of caustic soda. In preparations thus treated, especially in the use of methyl-blue the spores alone are stained while the bacteria themselves no longer take up color.

* Hueppe's methods of Bacteriological Investigation translated by Biggs, p 74.

If bacteria are examined in the hanging-drop shortly before the formation of spores in many of them refracting bodies are found which have not yet a size equal to that of spores. When the preparations, dried and fixed by passing them through the flame three times, are stained with an aqueous or dilute alcoholic staining solution, the bacteria in this stage are found to be stained, not so equally as before, but some parts are more deeply colored. This condensed protoplasm takes the dye more readily than the protoplasm not thus concentrated. Then follows the stage in which the refracting corpuscles become much more equal in size, but they still stain well; and finally the stage in which similar refracting corpuscles are present in the unstained preparations, but these no longer take up the color. Now the spores have first obtained an insusceptibility to the dye through the formation of a membrane difficult of penetration, which prevents the absorption of the coloring matter.

In the cover-glass preparations, which have been passed through the flame three times, the bacteria and nuclei are well stained. If they are passed through the flame more times, say six, the bacteria are stained successively worse, but the nuclei still absorb the dye as does also the condensed protoplasm of the bacteria which has not yet formed spores. At this stage, besides the nuclei, granular elements can often be seen which may easily impress one as belonging to the badly stained bacteria. If the preparations are passed through the flame still more times, say ten, then both the nuclei and the condensed protoplasm lose their susceptibility to the dye, and the spores gain it. In the case of some of the bacteria of putrefaction, it is sufficient to pass the preparation through the flame only seven times, but in others ten times are required. (In the dry-oven a similar stage is reached in from fifteen to thirty minutes at 180° to 200° C.) The spores then take up aqueous solutions of red, violet, blue, brown, and green basic aniline-dyes.

This isolated staining for the proof of the resistance of the spores, as Buchner intended, is perhaps sometimes to be used; but, since in this way nothing is learned concerning the relation of the spores to the bacteria, it is better to use a double stain. The procedure is almost the same, quantitatively increased, as that for staining the tubercle bacilli. Either the preparations, passed through the flame three times, are stained with a strong alkaline solution from twelve to twenty-four hours and afterward stained with vesuvin, or the aniline-water-dye solutions are used, of which that of Neisser, previously described, has proved to be the most convenient and satisfactory. Stain in hot aniline-water fuchsin, decolorize with nitric acid, then stain with methyl-blue.

Some spores, are stained, moreover, by saturated aqueous or dilute alcoholic solutions, if they are at the same time heated. The difference of spores in respect to their susceptibility to dyes, seems to be scarcely less than that of the bacteria themselves.

Slides Received.—We desire to return thanks to the donor for the following interesting slide:

Diatoms, prepared by A. F. Bartges, Esq., Akron, Ohio.

EDITORIAL.

Meeting of the American Society.—Notice is sent out that if 50 members will get certificates that they have paid full fare going to Detroit, it will be possible to secure return tickets at $\frac{1}{3}$ regular fare. This "if" implies doubt, and as a matter of fact in several past years there have not been 50 such members. Additionally, reduced hotel rates have been expected and not realized on some occasions. Unless the Society can control these two features the attendance will suffer, and indeed it had better hold its meetings in conjunction with the American Association for the Advancement of Science, which always does get return rates and reduced hotel fares.

Walter H. Bulloch.—We are glad to announce the early removal of another friend to Washington. This time it is the accomplished optician of Chicago, Mr. W. H. Bulloch, who comes here in order to accept a position in the Coast Survey. If his friends each give him one or two more orders at Chicago before the end of this month they will probably receive attention and perhaps some fine bargains in view of his closing business there. We shall be delighted to have him in Washington, and he may expect a cordial reception.

BOYS' DEPARTMENT.

Microscopical Examination of Starch.—The following paragraphs embody all the essential parts of an enticing article by our friend Dr. W. H. Sylvester, of Natick, Mass., in *The Observer*:

Starch is composed of minute white granules or cells which differ in size or shape in the different varieties of tuberous roots and plants. Starch may be detected by adding a small quantity of a solution of iodine to a mixture suspected of containing it. All starch grains without exception turn blue in the presence of iodine. Starch furnishes beautiful objects for observation and study. It is one of the easiest things looked at by beginners. The several varieties can be readily obtained, and there is not a cheap compound microscope that will not distinguish the grains.

Cut a bit of potato fine in cold water, let it stand half an hour, then turn off the water, and in a short time a sediment will be thrown down, which is the true potato starch. Place a drop of the sediment on a glass slide, cover with thin glass and look at it with a power of one-fourth to one-half inch. A much lower power will distinguish the grains. Small clam-shell-shaped bodies will be seen under careful focussing marked almost exactly like the surface of a clam shell, the most of the lines seeming to radiate from a dark spot in the centre called the hilum. In some kinds, as in arrowroot, the hilum looks very much like a crack in the centre, reminding one exactly of the crack in the centre of a potato that has grown too rapidly.

Different varieties of starch may be distinguished by measuring the grains with a micrometer, although many cells of each should be measured and the average taken as the size varies. For example, many of the larger grains of arrowroot exceed in size the smaller grains of potato starch, but the average size of the grains of potato starch is much larger

than the average size of arrowroot grains. Grains of starch from different plants vary in size from $\frac{1}{200}$ to $\frac{1}{3000}$ of an inch.

The polariscope will aid in the detection of starch in doubtful cases. All varieties show a most characteristic cross in the centre, often called St. Andrew's cross, and with a selenite plate a most beautiful object is seen. The play of colors is wonderful.

The largest starch grain is from the *Canna edulis*, the root of which is something like the potato. This starch may be procured under the name of "Tous les Mois" starch from Chas. W. Smiley, Washington, D. C. If any should wish to send, ask for Walter White's preparation, No. 170, an object well worthy of study. The grains of this starch are so large and the markings so plain that a very low power will suffice, while many other varieties require a high power to show them.

To mount for the polariscope always use balsam or damar; some prefer benzol balsam, but be sure that the starch is dry or milkiness will result. For the purpose of study always use some aqueous media, as the balsam renders the grains so transparent that the resolution of the markings is almost as difficult as to resolve *Pleurosigma angulatum* in balsam by central light. Any of the aqueous media would preserve the starch grains, but this is reliable: carbolic acid, six grains; glycerine, three drops. Mix and add distilled water, one ounce. If the cells are properly made and a plenty of gold size and cement is used over the glass cover, there will be no difficulty about the mount keeping.

The following method of mounting arrowroot starch moving in fluid is very valuable: Make a cell of four to seven layers of Brunswick black, sealing-wax cement, or of King's lacquer cement in scarlet or blue. Just fill the cell and *no more* with the above-named fluid. Put in almost enough starch to cover the surface; too much will defeat the object, too little may not give a sufficient amount of weight to make the granules roll. Cover and seal as usual. Do not forget to lay on a sufficient number of layers of good cement with at least a day for each layer to dry. The best plan in putting up fluid mounts is to begin the cell with gold size and finish it with the same, whatever else you may use for cement between these coats.

When dry and you wish to see the motion of the granules under the microscope set the slide on its edge for a short time to allow the starch to settle on one side, reverse the slide on the stage, incline the stand at least forty-five degrees, using a power not above one-half inch. The field will be full of rolling spheroidal bodies, some of singular form, and moving beautifully. They roll along from side to side, sometimes in a mass, sometimes one alone will start and roll across the field striking another granule, and one can imagine that he hears a clash as if two stones had struck together.

If when the slide is put on the stage the granules do not at once start it will be sufficient to remove and lightly tap the edge on the table or hand when on replacing they will be seen in motion. Those who have never seen the starch under these conditions are strongly urged to try this method. The arrowroot grain is the best adapted from the spherical shape of the grains.

One caution: do not use too high a power, as one of one-half, three-fourths, or one inch is far better than higher, as the structure is made out and a larger field is obtained in which to watch the movements.

MICROSCOPICAL SOCIETIES.

WASHINGTON, D. C.—L. M. MOOERS, *Sec'y*.

106th Meeting, May 13.—The Microscopic Life of the District (of Columbia) was the subject of an interesting paper by Dr. W. H. Seaman.

All living forms may be divided into plants and animals. In plants the forms which especially require the microscope in their investigation, in descending the scale of complex structure, are, in order, the ferns, mosses, lichens and algæ, and fungi.

The first three of these have been listed and published in the Guide to the Flora of the District, by L. F. Ward, as Bulletin No. 22 of the National Museum. The ferns were treated by the botanists of the Potomac Side Club, who began the work on the District flora after Brereton, and the mosses were done by Rudolph Oldberg, afterwards revised by Rev. E. Lehnert, and with the lichens published in a supplement to the flora. Good work has been done on the fresh-water algæ by Prof. E. S. Burgess, but no list has yet been published. The diatoms and fungi yet remain to be studied.

A complete series of animal life is not found in the District, because many of the orders are found only in salt water. Many of the smaller insects require the microscope for their identification and study, and this part of microscopic zoölogy has for some time been diligently prosecuted at the Department of Agriculture, by Prof. Riley and his assistants.

After pointing out the descending scale of animal life, and citing the best authorities and text-books to be consulted in their study, the Doctor hoped that some member or members of the Society would be found with opportunity to carry on and complete the history of the life forms of the District.

WASHINGTON, D. C.—L. M. MOOERS, *Sec'y*.

107th Meeting, May 27.—Prof. Richard Foster exhibited a new class microscope made by Queen & Co., explaining its construction and illustrating its advantages for class work. Its simplicity, ease of manipulation, and the readiness with which it can be used by a large class, make it a very desirable instrument for this line of work. A number of "home-made" accessories were shown by Mr. L. M. Mooers, comprising a warm stage, bull's-eye lens mounting, eye shade, slip for mounting opaque objects, etc.

108th Meeting, June 10.—The microscope as an aid in the detection of arsenic, was the subject of a paper by Dr. E. A. Gibbs. The various tests for determining the presence of arsenic were illustrated, and slides exhibited showing the use of the microscope as a confirmatory test. At the conclusion of the discussion brought out by the paper, Dr. Stowell exhibited a number of rare and interesting objects, among them a rib from a small skeleton covered with a hairy growth, the origin and nature of which, though already the subject of considerable investigation and correspondence, seems to be yet undetermined. This closed the meetings of the Society for the season, and adjournment was had to the fourth Tuesday of September.

SAN FRANCISCO, CAL.—WM. E. LOY, *Sec'y*.

May 28, 1890.—Dr. Montgomery exhibited the eggs of a minute insect, the Chigger (*Leptus irritans*). This is a parasite afflicting the human race, chiefly met with in the Mississippi Valley, and its presence causes great suffering to its host. In its habitat it is variously known as "chigger," "jigger," "red bug," and "harvest bug." It makes its appearance in the early summer, about the 1st of June, and continues to annoy human beings until the first frost of the season kills it off. The pests are most active in August, and are found on all kinds of vegetation, but especially on blackberry bushes. They are not likely to be found on cultivated vegetation, and do not thrive well in wet seasons. They attach themselves to the clothing, and immediately seek a suitable spot on the subject to begin operations. So far as known they do not infest any other animal. The female penetrates the skin and within a few hours completely buries itself. The body then begins to swell from the formation of eggs, and increases to five times its size. This causes irritation and swelling, accompanied by intense itching.

In Virginia the negroes remove the intruder with the point of a red-hot iron, and then poultice the wound with the universal panacea of the race—a fresh quid of tobacco.

Mr. Riedy and other members gave an exhibition of beautifully arranged slides, prepared by E. Thum, Leipzig. These consisted chiefly of beautiful diatom frustules, arranged in the form of rosettes, or interspersed with butterfly scales, and were shown with transmitted light and dark-field illumination. There was, also, shown a series of opaque objects, consisting chiefly of variously colored butterfly scales arranged in the form of vases with a bouquet of flowers, and hovering around the flowers a number of bees or humming-birds. When it is considered that these elaborate designs in their entirety are not distinguishable to the naked eye, and that from 100 to 500 separate bits of butterfly scales or diatoms enter into their composition, they are simply marvellous works of human handicraft. Another slide of a similar nature consisted of 100 distinct species of diatoms arranged in rows, and an accompanying catalogue gives the specific name of each. When viewed under the microscope these various preparations exhibit great brilliancy of coloring and perfection of arrangement.

June 4, 1890.—The meeting of the Society, held at 120 Sutter street, was a very important one, being the twentieth anniversary of its organization. An historical address was read by Henry G. Hanks. The reunion was one of general interest to those present, and of special interest to the few original founders who were able to attend.

The reading of the address occupied about one hour, and contained a brief sketch of the founding and development of the society. Those present were then invited to partake of refreshments, Colonel C. Mason Kinne presided and announced the following:

"Our Founders," response by Colonel C. Mason Kinne.

"Our Life Members," response by Jacob Z. Davis.

"Our Honorary Members," response by Professor George Davidson.

"Our Presidents," response by Dr. S. W. Dennis.

"Our Secretaries," response by Dr. C. P. Bates.

"Our Workers," response by Dr. J. H. Stallard.

"The Press," response by Professor E. J. Wickson.

- "Our Vacant Chairs," response by William Norris.
"Our Future," response by A. H. Breckenfeld.
"Our Friends," response by Professor E. W. Runyon.
"Our Future Members," response by Dr. H. W. Harkness.

NOTICES OF BOOKS.

Modern Science and Modern Thought. By S. Laing. The Humboldt Publishing Co., New York.

The principal results of Modern Science, and the revolutions they have effected in Modern Thought, are concisely presented. Here are displayed the results of recent inquiries into the composition and constitution of the earth and of the universe, into the nature and laws of matter, the development of organized and animated existences, the history of man, the myths of all races and the religions of all peoples; discussions of the nature of force, motion, electricity, light, and heat.

Utilitarianism. By John Stuart Mill. The Humboldt Publishing Co., New York.

There could be no better evidence of the good work being done by the publishers of "The Humboldt Library" than the present volume. They publish "Utilitarianism" at the modest price of fifteen cents, whereas the imported edition costs \$1.75. And yet this fifteen-cent edition is fully the equal of the London edition in type, paper, and presswork.

The Electric Light, and The Storing of Electrical Energy. By Gerald Molloy, D. D. The Humboldt Publishing Co., New York.

This number of "The Humboldt Library of Science" contains much information on a subject of supreme importance to the present generation. Dull, indeed, must be the reader who would fail to be instructed by the abundance of facts and wealth of illustrations here presented.

School Algebra. By Prof. G. A. Wentworth. 12°, 362 pp. Ginn & Co., Boston. (Price, \$1.25.)

This elementary algebra is intended as a High School text-book, and covers ground sufficient for admission to any American college. Great care has been taken in culling out the unimportant matter so that no time need be spent in learning that which is of no use in the higher branches of mathematics. The introductory chapter, which is always of the utmost importance, brings before the student in brief review the knowledge he has already gained from the study of arithmetic. The meaning of the negative quantities is also explained and the laws which regulate the combinations of different arithmetical numbers are shown to apply to algebraic numbers. The ground covered by the volume extends through logarithms and includes much of the matter treated of in the author's College Algebra.

Protoplasm and Life. By Charles F. Cox, M. A., 12°, 67 pp. N. D. C. Hodges, New York, 1890. (Price, 75 cents.)

This volume consists of two essays, the first on "Protoplasm and cell doctrine," and the second on "Spontaneous generation theory, and its relation to the general theory of evolution." The author of this book has been for several years president of the New York Micro-

scopical Society, and as would necessarily be expected the papers reveal his knowledge of microscopic studies. Throughout the author has shown his familiarity with the writings of Spencer, Huxley, Hæckel, authorities which he cites frequently and discusses intelligently. The author is a thorough and consistent evolutionist and by some will be considered bold, holding as he does that transition from not-living matter to living forms is an essential step in the process of evolution. The volume which is published in uniformity with the previous "Fact and Theory Papers" presents a neat appearance.

Practical Sanitary and Economic Cooking, adapted to persons of moderate and small means. By Mrs. Mary Hinman Abel. 12°, 190 pp. American Public Health Association, 1890.

Mr. Henry Lomb, of Rochester, N. Y., offered two prizes in 1888 for an essay on this subject. There were 70 competitors. The first prize of \$500 was awarded to Mrs. Abel. The committee reported in the highest terms of this essay, and the society has therefore published it. Our own judgment does not differ from that of the committee. In this small compass are presented a sufficient number of recipes, estimates of the cost of food, and its nutritive value; also a great number of valuable suggestions regarding the kitchen and its operations. Everything is so clear and concise as to be quite attractive. The book is sold at mere cost by the secretary, whose address is Rochester, N. Y. The book is so unique in all its aspects that it will demand the notice of scholars and of the best housekeepers as well as of women in families of moderate means for whom it was especially written. It ought to influence the economics of society and prove an aid to the solution of the industrial problems of the day. It will, if "a penny saved is as good as two earned."

SUBSCRIBERS' NOTICES.

[These notices will be given six insertions in this column at 25 cents per line or fraction thereof.

FOR EXCHANGE.—Slides of selected diatoms.

D. B. WARD, Poughkeepsie, N. Y.

WANTED.—Unmounted microscopical material, also micrographic dictionary. Will exchange or buy.

CHARLES VON EIFF, 124 Clinton Place, New York City.

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The Influence of Electricity on Protoplasm.*

By GEO. E. FELL, M. D.,

BUFFALO, N. Y.

What in part has called the attention of the world to the influence existing between these remarkable agents is, that in the medical world, at home and abroad, an awakening interest in the therapy of electricity has lately been aroused, unusual activity prevails; electricity is utilized more frequently than ever before in this field, and a more systematic method of application is in vogue. Another factor also is the controversy relating to the application of electricity in the execution of criminals. How death is produced by powerful electric influences, from a technically scientific stand-point, is as yet unsettled. It is reasonably anticipated that the investigations by many workers, lately undertaken, may result in clearing up the existing chaotic uncertainties, and that the true and scientific value of this wonderful agent in these fields may be definitely ascertained.

Furthermore, the arts and sciences utilize it to such an extent that the world looks on in amazing expectancy, awaiting eagerly the next electric stride in the amelioration of the conditions which now beset mankind. We are fast approaching the electric age of history, but stand awed in an attempt to contemplate its possibilities.

We will first consider protoplasm, as it exists in nature and its associations in the animal organism, with reference to the question of electrical conductivity. Demonstrating to my class the circulation of the blood in the web of the frog's foot, the field of vision presented the capillaries with the intermediate substance composed of numerous variously formed cell-like bodies constituting the tissues of the foot. Histological methods demonstrate that muscle, nerve, adipose, con-

*The Annual Address of the President before the American Society of Microscopists, Detroit, Mich., August 13, 1890.

nective, or other tissue, illustrated in the web which we examined, is alike composed of cells or units of protoplasm; vital tissue being therefore a mass of protoplasm.

Protoplasm exists only under certain conditions of environment; it is continually undergoing change (metabolism); its very existence depends upon its property of utilizing certain nutrient substances provided by various means for sustenance, and at the same time the effete products of its vitality must be removed.

We thus have assimilation and disassimilation as necessities, which are associated with every protoplasmic particle, from the unicellular amoeboid forms to the multicellular and more complex organisms of the mammalian type. This condition prevails, viz: that protoplasm, whether in the simpler or more complex organisms, receives its pabulum from its immediate environment. The living cell, vegetable or animal, is surrounded with a medium which provides material for assimilation. In the lower forms of life the micro-organism, bacterium, micrococcus, or spore, in aqueous surroundings, secures the oxygen necessary to its existence from the fluid in which it moves. In the higher organisms the circulatory fluid provides a similar condition, supplying to each cell its pabulum, enabling it to fulfil its function as well as retain its vital principle or condition. The microscope enables us to study the morphology of the cell and tissue, to note the varying aspects from the nucleolus to nucleus, to the variously formed tissues of the complete organism. Illustrations of this truth might be represented by the admirable study of the nucleolus and modifications in the living cell by Dr. W. H. Dallinger (Proceedings Royal Microscopical Society), wherein the varying vacuolar manifestations and movements of protoplasmic granules demonstrated that the extra vital substance was associated with the nucleolus. Another instance would be the work recorded by the embryologist, wherein the manifestations of vital changes from the embryo to various tissues, and growth to organs and the fully developed organism, is known to the minutest detail, and yet we must deplore that the vital principle, the immediate and present cause of all these changes, is beyond the power of the microscope to reveal.

The microscope might possibly indicate a slightly hyaline appearance to the living cell not present after life has departed, produced by the coagulated state of the protoplasmic mass. Herein lies one of the difficulties met with in the investigation of the subject; many reports indicate that in the death of animals (death of protoplasm) by powerful electric influence no modification of the tissue is discernible with the microscope. This is yet *sub judice*. Chemistry may help us here.

The composition of the tissue of the body has a marked bearing on the subject we are reviewing. As we are considering the relation of electricity to animal protoplasm, we will take up the more important substances relating to the composition of the tissues making the great bulk of the animal organism. That of greatest fluidity, the blood, has of water about 75 per cent., a fair percentage of salts chiefly components of potash and phosphoric acid (C. Schmidt). Muscular tissue, which forms a very large proportion of the bulk of the organism, has a jelly-like consistence.

The capillaries in the muscle form a fine net-work which in the active state of the muscle simulates somewhat that condition of conges-

tion produced by the passage of an electric current through living muscle, thus presenting an even greater state of fluidity to this tissue under such conditions. It must be remembered also that all tissue is sustained to a greater or less extent by a circulatory system, and that even among the more solid portions of the organism, bone has as much as 23 per cent. of water entering into its composition combined with the salts of the blood circulating in the canaliculi traversing it. The influence of adipose tissue and the epidermis, factors mentioned (Kemmler enquiry) as presenting a marked resistance to the passage of the electric current, must be considered in this connection.

The fat of the body is intermingled with the various tissues of the body, is also nourished by a vascular blood supply, and in very few instances (except possibly abnormal states) does it present an unbroken barrier to the electric force. In the epidermis, where the greatest resistance is offered, the vascularity produced by the sudoriparous (sweat) ducts, without taking into consideration the capillaries of the papillary derma, would, it seems, be sufficient to eliminate any uncertainty. Furthermore, it is well to note that the animal organism presents a somewhat compact mass with the exception of the intestinal canal and thoracic cavity in expiration; that outside of this there is practically no break of continuity to the passage of an electric current.

From these generalizations and the statement that fluids with the potassium and sodium salts are better conductors than pure water, it is reasonable to assume that the animal organism, through its great vascularity and chemical composition, presents a medium that may be looked upon as a fairly good conductor of electricity; its real value as a conductor will be considered later.

It may be noted that investigation of these subjects cannot well be carried on without utilizing the microscope. The unfamiliarity of many with the nomenclature employed in the discussion of subjects pertaining to electricity, requires a short explanation regarding the terms most frequently used. We assume that all are familiar with the methods of electro-decomposition, illustrated practically in electro-plating. The compound fluid termed an electrolyte being traversed by the electric current of sufficient strength to overcome the chemical affinity existing between its molecules, is broken up into a more elementary state and the metals, the salts of which were present in the fluid, are deposited at the electrodes. This effect is termed electrolysis; that electrode connected with the positive pole is the anode; that with the negative pole, the cathode; electro-positive elements appear at the negative, and the electro-negative elements at the positive electrode.

Electro-motive force is the power produced by the electrical generator, be it a galvanic cell, a voltaic pile, or a dynamo. The electro-motive force of a Daniell standard cell is one volt, the electro-motor unit of measurement. In a standard Daniell cell there is a uniform internal resistance to the transmission of the electro-motive force which is termed an ohm, and is the unit of resistance to the passage of the current.

The electrical current passing through a standard Daniell cell has an electro-motive force of one volt and is termed an ampere. Ohm's law is represented by the equation $C = \frac{E}{R}$, or the strength of the current is equal

to the electro-motive force divided by the resistance. From this it is seen that the strength of the current passing through an electrolyte, be it a portion of the human body or a decomposable liquid as in electroplating, is measured in amperes, or fractions of an ampere; the force of the currents in volts, and the resistance of the electrolyte to the passage of the current in ohms. In medical application of electricity the current strength is measured in $\frac{1}{1000}$ of an ampere or milliamperes, the sensory nervous system being incapable of withstanding strong currents. The milliampere-meter is considered an essential feature of the electro-therapeutical armamentarium, as with it the effects of weak or strong currents may be observed and systematically noted.

Density of the current indicates the relation of the strength of the current to the transverse section of the conductor which it traverses. This might be exemplified by allowing a contact with the top of the head and lower portion of the body of an animal; the density in the neck would be much greater than either in the head or body, owing to the less area of cross-section of the former.

THE INFLUENCE OF ELECTRICITY UPON THE LOWER FORMS OF LIFE.

Slight electric shocks from a coil (induced current) increase the rapidity of the protoplasmic movements; stronger ones cause tetanic contraction; and numerous and powerful ones produce coagulation. "A constant current causes contraction and imperfect tetanus; and if powerful and long kept up, the positive pole produces in the *amœbæ* near it the same changes as dilute hydrochloric acid, and the negative pole the same changes as are produced by an alkali, such as potash." Upon infusoria, weak electrical currents first quicken the ciliary motion and cause movements of rotation, then swelling of the protoplasm, slower movements, and, finally, apparent solution of the protoplasm. Moderate currents produce a tetanic contraction of the protoplasm, and of the cilia, while the contractile vesicle is unaffected. Strong currents cause liquefaction of the protoplasm. (Pharmacology, Therapeutics, and Materia Medica, by Laudr. Brunton, 1885.)

Dr. Klein, in the "Handbook for the Physiological Laboratory," gives an interesting account of the action of electricity on blood. He explains the method of placing the blood on a slide provided with two poles, when the cover-glass being placed on the slide, the examination is made. According to Rollet, it is advisable in using electrical discharges, that the tin foil poles should be six millimeters apart. The Leyden jar should have a surface of 500 square centimeters, and give a spark one millimeter long. If, then, the discharges succeed each other at intervals of from three to five minutes, the following changes are observed in the colored corpuscles of man: First, the circular discs become slightly crenate. This effect gradually increases, the corpuscles become rosette shaped, then mulberry shaped, and, finally, by the accumulation of the projections, horse-chestnut shaped. Later, the processes are withdrawn, the blood corpuscles become round, and at last, pale. The effect on the white blood corpuscles during their movements is to cause them to assume the spheroidal form, but they resume their movement as soon as the current, if not too strong, is discontinued; under the influence of successive shocks of greater intensity, they swell out, their granules exhibiting molecular movement, and finally disappear.

The blood taken by myself from the temple of William Kemmler, the first man executed by electricity, 7 minutes after the electric force had been turned off, presented marked peculiarities. Fully one-third of the field presented granular particles of protoplasm ranging from the full-sized corpuscle to the size of ordinary granules. Protrusion of the protoplasm from the corpuscles was frequently noted.

Without further consideration of the influence of the electric current upon the lower forms of life, it may be seen that the influence is positive in its character, that we have with the weaker currents an undoubted electrolysis produced, and with the stronger or a long continued influence of the current a lowered vitality of the protoplasm.

THE CHEMICAL OR ELECTROLYTICAL CHANGES IN TISSUE.

In considering this subject we will leave out the consideration of electrotonous, a condition produced in nervous and adjacent tissue by passage of an electric current, which has been quite fully considered by physiologists.

As to the influence of the Faradic current (alternating current) upon an electrolyte, testimony seems to favor the view that electrolysis is produced, although not in the same degree as with the galvanic current. The action of the continuous current may be illustrated by the treatment of a tumor of a vascular nature.

At the positive pole hydrogen gas will be generated, at the negative an alkalinity in the fluid will be produced. The blood filling the vascular growth, if a sufficiently powerful current be used, will gradually coagulate. Just what the nature of the effect of the continuous current upon the internodal fluids and tissues of the body may be, it is difficult to state, but the opinion of leading medical electricians is almost unanimous in favor of a change taking place. Amory, in his work on Electrolysis (page 127), says: "There are four methods by which electricity can be supposed to interfere with interstitial nutrition and in consequence of the interference, destroy the life of the cells, viz: 1st. By producing a true decomposition of the chemical compounds, upon whose combination the integrity of the living structure depends. 2d. By interfering with the natural processes of cell segmentation by which their proliferation and increase is effected; this interference would thus prevent the repair and multiplication of the cells whose living functions are essential to the growth of the living tissues. 3d. By promoting a movement of the mass of fluid in the living tissues towards the negative electrode, and thus interfering with the constructive metabolisms upon which interstitial nutrition depends. 4th. The acid and alkaline reactions at the positive and negative electrodes, respectively, from which a caustic action upon the tissues is effected through contact of these two different chemical reactions." Amory, in these statements, is endeavoring to find a rational cause for the destruction of abnormal growths.

As to special modification of tissue, in a discussion held before the New York Academy of Medicine, Nov. 27, 1889, Dr. A. H. Buckmaster recited the following experiments: The heart of an anæsthetized dog was exposed and a current of forty milliamperes made to traverse a portion of the ventricle. A piece of the ventricle in the direct line of the current was excised and another some little distance from the

direct influence of the current. When examined under the microscope, the pieces from the direct line of the current showed that the striæ had become markedly granular, while the piece outside of the direct line of the current preserved the muscle cells unaltered.

It was stated that this was the first evidence of absolute molecular disintegration of the living cells by the interpolar action of the galvanic current where such process is confined to the cells.

Dr. Frederick Peterson, of New York, from a series of experiments on cataphoresis with principally cocaine and aconitine, concluded (see Dr. A. D. Rockwell's article in *Medical Annual*) that with the former, or two combined, a deep anæsthesia may be produced in conjunction with the anode. The anæsthesia may be made rapid with the use of strong currents, or slowly produced with a current imperceptible to the patient.

Upon this subject we need not dwell further; catalysis takes place in living tissue; its precise nature is not understood. Cataphoresis, also a proof of catalysis, seems to be a demonstrated fact.

THE RESISTANCE OF TISSUES TO THE PASSAGE OF THE ELECTRICAL CURRENT.

In the application of electricity in medicine the electrode applied to the body is usually a sponge saturated with fluid and connected with the metal portion of the electrode. The greatest resistance is at the point of contact with the body, and the character of the fluid used has much to do with overcoming the resistance. If the resistance should be considerable, a cautery effect would be produced, if the current is kept up a sufficient time, and a series of burns might follow with sufficient electro-motive force. From a paper in *The Electrical World*, of May 26, 1890, the average of a series of resistance on the human body, made by Dr. W. T. Stone, is as follows: Foot to foot resistance of three adults gave 935 ohms. The average resistance from foot to hand of same parties gave 1,126 ohms. These from the context of report, are considered continuous current resistances.

In same paper, experiments conducted by Mr. Wm. Laut Carpenter, are interesting as showing the decreased resistance obtained by a steady continuance of application. Resistance taken from foot to foot with dry skin was 10,300 ohms, with salt and water to saturate electrode; in 1 minute 4,300 ohms, in 10 minutes 1,900 ohms, 20 minutes 1,540 ohms, 30 minutes 1,400 ohms, 40 minutes 1,250 ohms, 50 minutes 1,200 ohms, 60 minutes 1,190 ohms to 1,200 ohms.

In the same paper, entitled "Alternating v. Continuous Currents in relation to the Human Body," by H. Newman Lawrence and Arthur Harries, the authors present three series of measurements on ten adults of ages from 21 to 40 years. Tin electrodes, each of 50 square centimeters area, were used, the extended palms being placed on or grasping the electrodes. The conditions which might occur in accidental grasping of electrodes of conductors from dynamo currents were simulated as near as possible; the average of the three tables given were as follows:

Resistance to continuous currents.—Table No. 1, dry hands, 38,140 ohms; moistened with distilled water, 15,250 ohms; moist with salt water, 9,557 ohms.

Alternating Currents.—Table No. 2.—Dry hands, 4,155 ohms; moist with distilled water, 1,722 ohms; moist with salt water, 1,365 ohms.

Continuous Current.—Table No. 3.—Dry hands, 14,475 ohms; moist hands, 9,750 ohms.

Alternating current.—Dry hands, 1,740; moist hands, 1,437 ohms.

One feature is prominent in these results, viz., that the resistance obtained by the alternating current is very much less than that obtained with the continuous current.

Mr. Thos. A. Edison instituted a series of experiments to ascertain the resistance of the human body to the passage of the electric force; 259 male persons of all ages from 68 to 192 pounds, measured between the hands immersed to the wrists in caustic potash, aqueous solution of density 1.1, gave the mean of all resistances 986 ohms.

The deductions drawn from this extended series of measurements were as follows: The resistance of a man's body, taken between the hands, varies with the solution employed for immersion, and the area of skin immersed, together with the superficial condition of the epidermis. That with a fixed solution, immersion, and area, the resistance does not vary to any appreciable extent with the battery power used in the measurement, when the effects of polarization are eliminated. That with the KHO solution used as given above, the resistance at about 30 seconds immersion, is about 1,000 ohms. Why the resistance with the alternating current was not used is not stated. These experiments were brought about through the controversy on electro-execution, and from the great difference in resistance demonstrated by the English gentlemen referred to previously, between the continuous and alternating current, it would have been of great interest to have compared the results in so extended a series of measurements. Few who use electricity in medical practice will question the following statements of Dr. A. D. Rockwell, taken from "Kemmler enquiry," that the resistance falls more rapidly when a low potential is used and that the fall of the resistance-taking men ordinarily would range between 1,200 and 400 ohms, and that this fall of resistance would be almost instantaneous. That after the current has once overcome the resistance, the resistance is gradually lessened until about the minimum resistance is reached, when it remains nearly stationary under a constant potentiality.

THE INFLUENCE OF ELECTRICITY ON SENSATION.

Any physician practically using galvanism in his medical work will find that 20 milliamperes will generally be painful to his patients. In fact frequently a less powerful current will be objected to. It depends to a great extent upon the portion of the body operated upon. If a mucous membrane, even 5 to 10 milliamperes may prove very painful. As to the comparison between the painful effects of the continuous and alternating currents, a paper read before the Institution of Electrical Engineers, London, England, March 27, 1890, throws some light (see *Electrical World*, May 26, 1890). The writers adopt 10 milliamperes as the maximum continuous current which may be passed through the body without producing unpleasant sensations. With alternating currents they found a great difference, inasmuch that before a single milliampere was registered their patients complained that the current was too strong and practically unbearable. In the course of their investigations they found but few persons who could bear with comfort one milliampere of alternating current. From their experiments upon ten persons they found that one and seven-tenths milliamperes of alternating

current, was, on the average, all that could be borne without discomfort. Beyond that point violent muscular contraction, rendering relaxation of grasp difficult, and then impossible, produces distinct pain which agitates the whole body. They state, as their conclusions, that the human body can bear with ease at least five times as much of continuous-current strength as of alternating-current strength. Dosage of electricity is somewhat similar in results to that of many dangerous drugs. If the dose is insufficient to kill, the result, owing to the influence on the system, may range from a slight to a most serious effect. Where powerful doses of electricity have been received and the party survived, it is to be expected that recovery will be associated with painful sensations which may vary greatly in degree. In railroad disasters, for instance, we have surgical shock from that which produces momentary paralysis to that which produces apparent instantaneous death. This applies to many cases of recovery from powerful shocks of electricity; testimony is quite uniform to the effect that no sensation was experienced by the patient at the time of stroke. This can only be accounted for by the assumption that the electric influence is so rapid in action that sensation cannot be transmitted to the brain centres before they are paralyzed by the electric force.

The testimony of many who have received powerful electric strokes and recovered is almost unanimous regarding the entire absence of sensation. In all cases where the cerebrum has been influenced, this question may be decided in favor of entire loss of sensation. Had the sensory apparatus of the body time to act under these shocks the recipient would, undoubtedly, be cognizant of it after recovery. I will refer to an experiment with the Kemmler chair later having a bearing on this question of sensation.

THE PRODUCTION OF DEATH AND THE UTILIZATION OF ELECTRICITY IN THE EXECUTION OF THE DEATH PENALTY.

The controversy occasioned by the passage of the electro-execution law by the State of New York, has a direct bearing upon our subject. I propose to give tersely its history and my connection with it. The following report of experiments made by myself is copied from that of the commission appointed by Governor Hill, of New York State, to inquire into the most humane method of executing criminals. This commission consisted of Elbridge T. Gerry, Dr. A. P. Southwick, and Matthew Hale.

In the month of July, 1887, there was conducted a series of experiments, calculated to throw considerable light upon the powerful and injurious effect of electricity upon animal life. The authorities of the city of Buffalo, N. Y., had determined to rid the city of the numerous curs roaming the streets. To reduce their sufferings to a minimum, the agent of the Society for the Prevention of Cruelty to Animals recommended that electricity be applied as the death-dealing agent. The experiments were conducted at the improvised dog pound prepared at old police headquarters.

The canines were quartered in one room; adjoining this was an entry which communicated with a third room, in which the electrical apparatus was located. This consisted of a common pine box lined with zinc, and connected with one pole of the electric-light current for

a portion of the city. When in use the box was partially filled with water. Connected with the electric-light wire representing the other pole, was an ordinary dog muzzle supplied with an iron or copper bit, which was inserted into the mouth of the canine. The animal being placed in the box, the switch making the circuit was turned, causing the apparent instantaneous death of the animal. Only in exceptional cases were any movements noted after the current was made. The result obtained by experiments conducted in this manner leaves the subject just where public opinion would place it, viz., "that electricity will kill quickly." However, to ascertain how quickly and thoroughly requires further demonstration.

The heart may rightfully be considered the centre of function, and in the execution of criminals by the legalized hanging process, is always examined to ascertain when death ensues. In favorable cases it is known that the heart may beat from eight to ten minutes, and in some cases it has been known to beat from fifteen to thirty minutes before death. For the purpose of ascertaining the effect of the electric-light current on the action of the heart, the operation of opening the thorax of an animal under forced respiration was made. With the operation satisfactorily performed, the heart and lungs may be observed in action, viz., the heart beating and the lungs contracting and expanding as in life.

While the operation is not new to physiologists, still I do not believe that the effect upon the movements of the exposed heart, by the passage of an electrical current which might be applied in the execution of criminals has been frequently noted or the operation often, if ever before, performed. That the ordinary electric-light current used in these experiments is sufficient to cause instantaneous death of a human being, is inferred from the many accidental deaths produced by such means. To witness the effect produced upon the heart in action is a demonstration which cannot be questioned, and offers a positive answer to what may have been inferential. To those favoring electricity as the proper agent in the execution of criminals, a demonstration of this character serves to make them more positive and less liable to be influenced by those whose investigations into the subject have been only superficial. Those opposed to it from the stand-point of uncertainty of action, it leaves without a foundation upon which to base their opinion. Prior to these experiments, I held the view that electricity might prove the best agent for executing criminals; after they were made, I enthusiastically supported it as the only agent which this age had any right to use for this purpose.

But to refer to the experiments: A fair-sized dog was placed under the influence of chloroform, an incision made in the trachea, in which a tube connecting with foot bellows, and supplied with suitable valve for respiratory purposes was attached. Respirations were then kept up by these artificial means. The chest walls (thorax) were then removed so that the heart and lungs were exposed to view; the dog was then placed in the zinc-lined box, the muzzle put on, the forced respirations kept up until just before the current was made. The heart was beating as in life, but the instant the circuit was made it ceased its action and became a mere mass of quivering flesh; not the least resemblance to a rhythmical movement was observed after the current was

made. The interference with all functions was electrically instantaneous; death ensued from electric shock; the ordinary conditions of dying were absent; nothing could be more sudden.

In an other experiment with a dog the heart was beating rhythmically; on making the circuit it instantly ceased to beat. The current was quickly turned off and forced respiration kept up with the view of bringing the heart again into action; this was entirely unsuccessful. The result demonstrates that if the current used is sufficiently powerful, attempts at resuscitation in the case of a criminal executed by electricity would certainly fail. In this second experiment it was also noticed that an attempt to respire was made by the animal after the current was turned on. This undoubtedly indicated that the respiratory centre in the brain (medulla) had not completely lost its susceptibility to impressions, and that, through the want of oxygen in the blood and centre noted, the effort to breathe was formulated. This has an important bearing upon the apparatus to be used in executions, inasmuch as it indicates that the poles should be arranged to pass the current through the centres of function in the brain. Upon physiological grounds, also, this is indicated. Even without this refinement of precision in the apparatus, as has been shown in this last experiment where the current was not passed directly through the functional brain centres, the sudden stoppage of the heart would indicate that electricity offers the most rapid agent in producing death that we have at our command. From these observations the following deductions may be drawn:

First, that death produced by a sufficiently powerful electric current is the most rapid and humane produced by any agent at our command.

Second, that resuscitation after the passage of such a current through the body and functional centres of the brain is impossible.

Third, that the apparatus to be used should be arranged to permit the current to pass through the centres of function and intelligence in the brain.

When this report was prepared it was understood that it was to go before the legislature of the State of New York. It was the only record of actual demonstration in the report of the commission bearing upon the subject in question. That it was influential in the passage of the electro-execution bill goes without the saying. The report has been criticised as not covering electrical measurements. I was limited in apparatus, and accomplished as much as was possible with the means at my command.

To the physiologist accustomed to demonstrate the action of the heart and lungs in life, it is noticeable that the heart does not spontaneously cease its rhythmical movements. It dies slowly, the movement becoming more and more labored until it ceases. To all who witnessed the experiments just reported, the sudden stoppage of the heart appeared to indicate a special influence of the current on that viscus. Subsequent experiments by many experimenters have proven the correctness of these conclusions.

The next series of experiments took place under the direction of Harold P. Brown, Esq., at the Columbia College School of Mines, New York City. A large dog was given 300 volts pressure, and then 1,000 volts of continuous current, without injury, but 300 volts of alternating current caused instant death. August 3, 1888, at the same in-

stitution, another series of experiments was made by Dr. Cyrus Edson and Dr. Chas. F. Roberts, of the New York Board of Health; the results of these observations, made to determine the danger of the alternating current, were as follows: A dog weighing 61 pounds in good condition, resistance from left front leg to right hind leg 14,000 ohms; (272) two hundred and seventy-two volts with 288 alternations per second killed the animal; heart ceased beating in 90 seconds. Dog immediately dissected by Doctors Robert and Peterson. Sections of sciatic and pneumogastric nerves, muscular fibres of lungs and diaphragm examined microscopically; no change in the structure observed.

As the heaviest of several dogs killed weighed but 91 pounds, it was claimed that the experiments could not be regarded as a criterion for the effect of the current upon a human being, and a further series of experiments were conducted by Harold P. Brown, at the Edison laboratory. A strong and vigorous horse weighing 1,230 pounds, and two calves weighing respectively 124½ and 145 pounds, were killed by the alternating current at 700, 770, and 750 volts. In all of these instances death is said to have been instantaneous and painless. A report of a committee of the Medico-Legal Society recommended that the alternating current be used for the execution of criminals. The details that are interesting in this report are as follows: Regarding the application of the death current to man, it is stated that the average resistance of the human body is 2,500 ohms. In the application of the current for executions, the recumbent or sitting position was suggested. It was recommended that one electrode might be placed in contact with the head, and one electrode upon the spine between the shoulders, or, as I had previously reported in the conclusion of my first experiments, the current should be made to pass through the functional centres of the brain.

A dynamo generating the electro-motive force of at least 3,000 volts should be employed; and a current used with a potential between 1,000 and 1,500 volts, according to the resistance of the criminal. In one of their experiments, upon the suggestion that the current should be applied through wristlet electrodes, upon, I presume, the theory that death would be as instantaneous as when applied to the brain centres and so as to include the heart, they applied the current to the four legs of a horse, but found that the method was not nearly as effective as when applied to the head and back. These experiments are recorded in the appendix to the testimony (Kemmler enquiry) before the Court of Appeals, State of New York.

The next series of experiments became of intense practical interest, as the dynamo used was that provided by the State of New York for the execution of criminals at Auburn Prison, and with which it was thought the first electro-execution would be produced. As I took a prominent part in this and a subsequent experiment at the same place, I will naturally be able to give a more detailed account than those with which I was unacquainted. The commission appointed to examine the apparatus preparatory to final purchase by the State, consisted of Carlos F. Macdonald, M. D., A. D. Rockwell, M. D., and Louis H. Landy, Ph. D. In addition, Gen. Austin Lathrop, Superintendent of State prisons, Harold P. Brown, who furnished the apparatus, Mr. Chas. F. Durston, warden of Auburn Prison, and myself, were also present.

From the report of the Commission I gather the following facts relating to the power of the dynamo: The commercial voltage, 1,680; the mean voltage, 1,512; the maximum voltage, 2,376; speed of dynamo, 1,700; speed of exciter, 2,700. In the alternating dynamo the maximum of the electro-motive force obtained in the rapidly changing alternations, or the mean of them, may be taken as the electro-motive force of the dynamo. Hence, the varying voltages given as above by the Commission. Regarding the difference between the alternating current and continuous current, we may note in explanation that the continuous represents a steady electro-motive force in one direction as in the galvanic current, while the alternating current simulating the Faradic or induced current at each alternation proceeds from zero to the maximum and recedes to zero, and repeats this in the opposite direction. The definition given by the committee of the commercial voltage of an alternating dynamo, is as follows: "Say fifty volts is such an alternating voltage as will, upon an incandescent lamp or Cardew volt-meter, produce the same light and heat effects as fifty volts in the case of a continuous current."

The commission having made their tests, wires were carried to a shed adjoining the prison. An old but vigorous horse, weighing some 1,200 pounds, had been secured. One electrode was secured above his eyes with cords and the other was also attached above the knee-joint of left hind leg. The electrodes were of copper plate, with cotton waste attached; the cotton was saturated with warm water, which was poured over them after being attached. One noticeable feature on this occasion was the anxiety of all present regarding the outcome of the experiment. All the gentlemen present had witnessed the death of animals by electricity previously, and believed in the efficacy of the agent; however, this was the first experiment with the dynamo, which it was supposed would soon be used in the execution of a human being. The experiment being made upon a large horse a slight failure would not, of course, be so serious a matter. The resistance of a horse, with the current passing through the whole length of the animal's body, would naturally be very much greater than that which would be presented in the body of any culprit. Still it would have dampened the ardour of all interested in a successful result. Noticing a diffidence on the part of the gentlemen present, I took off my coat, donned my physiological laboratory apron, and went to work. I was requested to turn the switch, and all breathlessly watched with interest the result of the shock. The horse by this time was standing quietly in one corner of the shed undisturbed as to what was going on about him. When it was ascertained that the dynamo was in full operation, I took my stand upon the box, and with my hand on the switch, watched the horse as I made the connection; he immediately stiffened out and fell to the ground dead. The current was kept up twenty seconds, and yet there was not a move on the part of the animal. The moment the current was turned off, with several assistants I removed the electrodes attached, made a slit between the ribs, in which I thrust my hand with the idea of detecting any heart action. There was none; death had been instantaneous. A good-sized calf was then taken and the electrodes applied to the head and spine as I suggested; I turned on the current, and as before the animal was instantly dead. The current was turned

off, having been acting ten seconds; electrodes were removed; I made tracheotomy and applied forced respiration with the same instrument with which I have saved five human lives. It was kept up for half an hour, and at no time was there any heart response.

I desire to state that this animal was placed under the best condition known to medical science to live after the shock had been given. I made this experiment not with any belief that the animal which had received such a powerful electrical shock could be revived, but merely to satisfy those who had been influenced by the ignorant statements, made in some portions of the "Kemmler enquiry," to the effect that animals which had received a large dose of electricity might be revived if placed in the ground for a period of time, until the electricity, said to have saturated them, had been drawn from them by the moist earth.

These experiments, as all the others I witnessed, presented no feature of uncertainty; no sound or cry was made by the animals, and as I had formerly advocated the use of electricity as a death-dealing agent, I could not but feel satisfied with the results.

And now comes the question of the method of application of this agent to the execution of a human being. At the time these experiments were made, the electric-execution plant at Auburn was in a decidedly chaotic state. Considerable labor had yet to be expended to place it in satisfactory condition.

THE KEMMLER CHAIR.

No chair suitable, or accepted by those in authority for the purpose, had been prepared. One illy adapted to the purpose was lying in the vaults of the prison, known as the Harold P. Brown chair. As the execution of Kemmler had been ordered by the courts, it was natural that those in authority should feel the necessity of prompt action. Following the above experiments, on the train returning home, I explained to Gen. Austin Lathrop, Superintendent of State Prisons, my views relating to the feature of the chair to be used. At his request I subsequently made drawings and specifications, and was requested (Letter January 16, 1889) to have a chair made according to my views. I carried out the idea I formerly expressed, viz: that the current should be made to pass through the centres of function and intelligence in the brain, etc. One electrode was placed over the cerebrum, the other against the spine in the dorsal or lumbar region.

The dissemination of the current with electrodes thus applied would include the heart and produce the greatest density in neck, including the region of the medulla oblongata. February 12, 1889, the chair was shipped to the warden of Auburn Prison, Mr. Chas. F. Durston.

At the request of Gen. Lathrop, I had kept the manufacture of the chair a secret, so that no notice had appeared regarding it. The chair was constructed in Buffalo under my direct supervision, and in its details differed considerably from any previously suggested. Every *practical* feature, even when used at Kemmler's execution, was original with myself; it resembles an ordinary heavy oak arm-chair, with perforated wooden seat, the cross-pieces at lower portion of back removed to give room for spinal electrode. Two upright pieces at the back of chair permit a third upright piece to move between them. This carries a

strong arm at upper end which projects forward over the head of culprit, and carries the head electrode, which may be secured at any point by simply turning a binding screw which secures the upright piece supporting the electrode; by this means the chair can be used for a large or small individual. A foot rest, which can be pulled out from under the seat of chair, has a cross or body piece provided to prevent the feet or body from sliding forward when a current is applied and rigor of the muscles ensues. This foot rest was not used at the execution. Without this, however, the straps supplied secure the body from moving. Straps are provided to secure the arms and limbs from movement. One passes around chest holding the upper portion of the body from moving forward; a combination chin and forehead mask prevents any movement of the head.

The spinal electrode is held in place by a strap which is attached to each arm of the chair; another strap secures it to the criminal, while an abdominal strap pulls the body backward against it. The head electrode is provided with a spring which takes up any downward movement of the head if it should occur, and with the spring of the rubber cups forming them, the combination effectually prevents any possibility of the culprit executing a sudden movement to escape contact with the electrodes. The electrodes are circular, four inches in diameter. Each one is surrounded by a rubber cup with the edges of its slides flattened so as to fit closely the body or head. The electrodes are brass, perforated plates, covered with sponge, and secured to the large wire which passes through the rubber cups to be connected with the dynamo wires. When the electrodes are in place, and properly arranged, the edges of the cups press against the head and body. Openings are provided so that the saturating fluid may be applied at any moment previous or during the passage of the current, with a long rubber pipette with large bulb provided for the purpose. The spinal electrode can easily be attached to the criminal before he is seated in the chair, and connected with the dynamo wires later, if desired.

In a letter to Gen. Lathrop describing the chair, I stated as my belief that it would accomplish the work for which it was constructed, *if sufficient electro-motive force was used*, and in such a manner as to take away from public executions the horrors which frequently attended them. In my laboratory I had passed a galvanic current through the electrodes when applied to individuals who had allowed me to experiment with them and thus demonstrated that the method devised for attachment of electrodes would offer a minimum of resistance when suitable fluids were used. In these cases a flash of light was noted on the instantaneous make and break of the current. With five volts electro-motive force and a current of five milliamperes a flash would be produced with the most rapid making and breaking of the current, indicating (so far as the senses could appreciate) instantaneous passage of the current through the body and indicating in degree the rapidity of death by this method. By accidental contact 10 to 12 volts were passed through a young gentleman in the chair; he was stunned, almost rendered unconscious, and quite thoroughly frightened. When it is considered that the current as applied passes through all the vital centres of the body, beginning at the cerebrum, the centre of intelligence, and taking in the cerebellum, medulla oblongata, heart and

lungs by diffusion, diaphragm, and spinal cord, the effect of the powerful current of a dynamo upon a culprit may be appreciated.

In sequential order the next experiment took place at Auburn, New York, during the week beginning April 28, when Kemmler had been sentenced to die according to the new law. The witnesses to this proposed execution, as is well known, through legal processes, did not see Kemmler die. There was a natural desire, however, to see the power of the apparatus applied to an animal, and Mr. C. F. Durston procured a good-sized calf for this purpose. I took entire charge of this experiment, and knew from experience that even with the assistants the attachment of electrodes which were removed from the Kemmler chair weighted down with a long heavy wire, to the head and spine of a calf is no easy task. The calf was overcome and quietly lying on the floor when Mr. Durston (at my request) turned on the current of about 1,200 volts e. m. f. Instant rigidity of the animal resulted. In ten seconds I gave the signal to turn off the current, the rigidity passed away;—the animal had been instantly killed. Previous to the application of the current I secured some blood from the animal; about an hour after I also took some. Microscopical examination revealed that the corpuscles taken subsequent to death were markedly crenated; which, I believe, on comparison with blood from a calf killed by a butcher, however, to be a *post mortem* change.

As by experiments on the lower animals, we can only arrive at conclusions regarding the death-dealing influence of electricity, I wish further to refer to the work of Dr. Edward Tatum, of Yonkers, N. Y., made at the University of Pennsylvania. In a letter he states that dogs were the only animals used.

It is understood, of course, that his results are, in strictness, only applicable to dogs.

“These results are, in brief, that with currents of between one and three amperes the heart is distinctly stopped before the current has produced any other discoverable lesion; and this even after the division in the neck of both pneumogastrics, or the profound poisoning of their terminations in the heart substance by curare or atropine; or, even after the chest wall has been opened. The stronger the current the more distinctly and independently is the separate action of the heart recognizable, and the more unavoidable is the conclusion that the result flows from a direct action on the heart substance of that portion of the current which actually traverses it.

“Currents of less strength than about one ampere may require from one to many seconds before the heart is arrested. As this interval is lengthened the interference with pulmonary respiration assumes greater importance, until a point is reached when it may be said that death results from simple suffocation. These results were obtained with the sort of currents that are used commercially, namely, continuous currents as well as very rapidly alternating ones.

“The strongest current that I have applied to a dog was about three amperes, requiring a pressure, with carefully applied electrodes, of between 900 to 1,000 volts, and consuming about four actual horse-power. Such a current has killed when continued for only one-eighth part of a second. The maximum volume of mixed gases that this cur-

rent could liberate in that time, under the most favorable circumstances, in a sulphuric acid volt-meter, would be less than $\frac{1}{5}$ of a cubic centimeter (at the temperature of the body). This power is equivalent to the liberation of heat of 0.71 kilogram degrees, centigrade, in one second, and in $\frac{1}{8}$ second would be able to raise the temperature of a 15 kilo dog about the one hundred and fiftieth part of one degree, centigrade."

In a letter dated May 27, 1890, Dr. Tatum refers to his article in the *Electrical World*, and to certain facts which they seem to prove as follows; (some of them have an important bearing on the Kemmler enquiry):

"1st. In only three of the twenty-four dogs killed did the heart fail to be arrested distinctly before respiration. In these three no priority could be assigned to the failure of either function. But in the twenty-one other dogs, effective respiration survived the final heart arrest. [Apply this to Kemmler case.] It often began with normal or slightly exaggerated force, and a good rhythm; then died out more or less gradually, but with no final convulsions. Fair inspirations were recorded in several cases as long as four or five minutes after a dose which had lasted only one second, but after which the heart had not executed a single beat that could be detected.

"2d. Contrary to what I believe has been the general impression as well as my own, the two cases in which I used currents with 120 reversals per second, seem to indicate that, if fatal results are at all dependent upon the rapidity of alternation, 120 reversals per second are slightly more mischievous than 300.

"3d. Alternating currents, as has been long supposed (though on what seemed to be sufficient evidence) can, for a given time and mode of application, bring about a fatal result with only a fraction of the electrical output required by continuous currents. But even here a certain respectable density of current is required. For the least neck density of alternating current that proved fatal was somewhat greater than one-fifth of the least fatal density with continuous currents.

"4th. The noteworthy fact was developed that under ether, this difference in fatal power between continuous and alternating currents either entirely disappears (4 dogs) or is at least conspicuously lessened (2 dogs)."

The doctor then attempts to account for the difference in fatal power under ether in these words, "it seems to be both a necessary and an adequate explanation, to refer it entirely to the well-known superiority of interrupted or alternating currents as nerve excitants. This property normally enables alternating currents to add to whatever direct physical action they may in crippling the heart muscle, all the physiological energy of the cardio-inhibitory nervous mechanism; but of course it loses its importance just in proportion as the nervous control of the heart is weakened by ether."

The fact still to be emphasized is that this superiority of alternating currents is not owing to any part of lesion or paralysis or exhaustion of any part of the nervous mechanism; but rather to the calling into action of a truly physiological function depends for its manifestations upon the integrity of this mechanism.

“In spite of the strong general opinion against my position, I had been able, until this last series of experiments was undertaken, to believe that there was no important difference between the fatal powers of continuous and alternating currents (when either effective voltage or effective current was considered), that the modes of action were identical, and that, therefore, I had only one sort of death to account for. This happened because, when I had originally determined that continuous and alternating currents were of equal power under ether, and that continuous currents were not influenced by ether, I had falsely inferred that the effect of alternating currents was equally independent.”

The experiments discussed in the *New York Medical Journal*, of February 22, 1890, seemed to me to show clearly enough that, under the conditions there noted, death was not caused by any sort of tissue lesion outside the heart. But these ether experiments proved that, with normal dogs and alternating currents, no lesion whatever can be taken into account. For under ether dogs can tolerate, without injury, currents three or four times as great as have ever been survived without ether. And it would be absurd to suppose that ether could protect any tissue against physical lesion from alternating currents so as to reduce their power exactly to that of continuous currents, and yet have no effect on the action of continuous currents.

In one of these experiments under ether, 1.05 ampere alternating current was passed through a dog from forehead to thigh (after four other applications gradually approaching this in strength). This is just three times as strong as the strongest current that I have yet used in killing a dog without ether. It is four and three-quarters times as strong as any dog has survived without ether. Yet one hour after this surprisingly large dose, the animal, being fairly recovered from the ether, the thing abnormal in his condition was a mild, general, rhythmical tremor. At this time also, after a little coaxing, he walked across the room and drank some milk. The next morning the dog presented no sign of having been misused; but in disposition and demeanor was entirely natural. He so remained until the fifth day after the large dose, when he succumbed to .245 amperes, after these other doses gradually approaching this strength, or less than one-quarter of the current survived under ether.

Dr. Tatum's paper, February 22, 1890, No. *N. Y. Medical Journal*, regarding some of his experiments, says: Whereas a current of one ampere, passed in either direction for one full second between the head and thigh of a dog weighing not more than sixty pounds, and representing in the neck a current-density of as much as a ten-thousandth of one ampere to the square millimeter section, invariably causes immediate and permanent arrest of both heart and respiration; yet a current of two and a half amperes has been passed for several seconds from one hind leg to the other of a much smaller dog, and representing a current-density ten times as great as that just mentioned, and the dog has immediately afterward risen to his feet and walked away.

From this and the negative results which the microscope gives in examination of the heart of animals killed by electricity, we may say with the doctor that somatic death may be caused without serious lesion of either substance or functions of muscles or nerves, but also that, when such lesions do occur, they are in no sense the cause, direct or indirect,

of death, and can only have resulted from a great excess of current above the fatal strength. A dog was killed by passing a smooth, continuous current of 0.4 ampere between the head and thigh, the positive pole or electrode being applied to the head. The current was then maintained of the same strength and direction for one hour and forty minutes longer, interrupted only by nine momentary breaks, made for the purpose of testing muscular contractility. By the end of this time the whole body was in a fairly firm rigor. This had been first noticed at the end of forty-five minutes, beginning in the neck, extending then to the muscles of the back, and appearing in the thigh, to which one electrode had been applied, rather sooner than in the other extremities. Yet, after this prolonged application of a fatal dose there was no sign of tissue disintegration, or of any liberation of gases in the tissues, or in the blood-vessels; nor any lesion whatsoever except a light ecchymosis between the skull and scalp, immediately under the electrode. If there is any change at all wrought in the blood, then it is not in the nature of ordinary electrolysis; nor is it of a sufficiently gross character to be readily detected with the microscope; nor does it evidently alter the physiological character of the blood. Until at least the existence of some change is proved it is useless to speculate on its possible nature or consequences.

Respiration may be suspended or inhibited without the immediate arrest of the heart; and, on the other hand, the heart may be instantly and definitely arrested while the respiratory mechanism yields only gradually. A current of one ampere passed between the head and thigh for one full second, in either direction, or an alternating current of the same virtual strength for one second, has always stopped the heart-beat and respiration at once. And, further, the most fatal mode of application has been when one electrode was placed immediately over the heart region. For in three experiments where this plan was tried the heart was stopped by a strength of current and a duration of closure decidedly less than ever sufficed when the current was passed from the head to the thigh.

Dr. A. D. Rockwell has kindly expressed his opinion on the subject of death from the electric shock: "In regard to the cause of death by the electric shock, I do not feel competent to say more than that it seems to instantly paralyze the heart through its action on the nerve centres. I have witnessed a number of *post mortems* after accidental death by electricity and in every case there was an absence of even a suggestion of tissue lesion—the heart only excepted—and even in this organ the minute effusions following capillary rupture were due to its sudden and powerful contraction and not the direct action of the current itself."

Interesting in this connection is the report of Prof. S. H. Gage of Cornell University, upon the results of examination of the heart of a calf killed by the Kemmler-chair electrodes at Auburn:

"In examining the calf's heart muscle sent me, I made sections, stained and mounted in balsam; part of the tissue was isolated with caustic potash, and part simply dissected with needles and mounted in glycerine. In order to have a criterion to guide me the heart of a calf butchered in the ordinary way for food was obtained, and examinations made while it was fresh, and then after treatment with alcohol, as described for the heart received from you.

"In the examinations, preparations were taken from the same part of the heart in the two specimens and treated precisely alike.

"Results: After comparing parallel preparations made as described above, I am compelled to say that no constant differences could be found. All the examinations were made finally with a Zeiss Apochromatic, $\frac{1}{2}$ ocular x 12.

"There was an indication in the balsam preparations of a difference. In the heart killed by electricity the longitudinal striation of the muscle cells was very clear, the fibrillæ seeming to be separated by a comparatively wide clear line, and in the fibrillæ the dark band was very marked, giving the appearance of a row of light and dark cubes. From the width of the interfibrillar light line the transverse striation was not so marked as the longitudinal. Later the distinction broke down as similar, if not quite so marked, appearances were found in the heart muscle of the butchered calf.

"The nuclei of the muscle cells were scrutinized with the greatest care, but no difference could be discovered. I am sorry not to be able to give a more satisfactory report, but the subtle fluid seemed to kill without leaving gross enough marks for me to detect."

The result of examination by Wm. C. Krauss, M. D., Professor of Pathology, Niagara University, Buffalo, N. Y., of brain of same calf killed at Auburn:

"The left hemisphere and cerebellum immersed in alcohol were presented me for microscopical examination.

"*Microscopic Examination.*—The specimens are in good state of preservation; pia is not adherent; pial vessels are somewhat injected; convolutions present no abnormalities; brain substance is firm and resistant, not brittle, and shows no petechial extravasations on section. There is a slight discoloration of the pia and underlying brain substance over the frontal and occipital lobes. This, no doubt, was produced by the electric current, and the discoloration, in all probability, is the result of thermic action.

"The brain was further hardened in alcohol for three weeks, and small sections taken from the frontal, parietal, temporal, and occipital lobes were imbedded in celloidin preparatory for cutting. No difficulty was experienced in cutting very thin sections. The staining methods used were ammonia, carmine, hæmatoxylin, and Niessl's magenta red.

"The sections took an indistinct diffused stain, the ganglion cells, etc., lacked that sharpness and clearness of outline which characterizes normal brain tissues. Whether this was the result of chemical change or to some fault in hardening, I am unable to say.

"As to the physical condition of the ganglion cells, there appeared to be no material change; nucleus, cell body, and poles were in normal condition; the same was true of the vessels and neuroglia cells. No evidence of hemorrhage into the brain tissue could be discerned. The periganglionic spaces were found free and unobstructed. The result of the microscopic examination is therefore negative as far as the physical condition of the separate brain elements are concerned. Whether the diffused appearance of the sections can be attributed to some chemical change in the protoplasm, I leave unanswered."

The execution of Kemmler having been set for the week beginning

Aug. 4, 1890, on the 5th inst. the committee of "reputable citizens" provided by law met at the call of Warden Chas. F. Durston, at Auburn Prison. Your humble servant was constituted an official "reputable citizen" for the first time in his life. Lately, through the press, you may have heard something about their doings at Auburn. Without entering into the preliminary details of the execution I will proceed at once to give a short account of this first official taking of human life by electricity. Since the former proposed execution, changes had been made in the location of the apparatus to be used for this purpose. When the calf was killed at Auburn, the entire plant of the execution was in one room, with the exception of the dynamo, which was some two or three hundred yards distant in a separate portion of the prison. Communication with the engineer was by an electric bell. The chair had been removed to another room, so that to witnesses of the execution there was nothing whatever to indicate when the current was working favorably. The lamp board, the switches, the ameter, the volt-meter were in an adjacent room. The intent of this arrangement was that it might be concealed from the world whom the individual might be who turned on the fatal current. The chair was arranged in the centre of one end of the room and securely fastened to the floor and perfectly insulated from it. One wire passed to the spinal electrode and the other was carried up to the ceiling and brought down to the cerebral electrode. The attachment of the spinal electrode had been modified somewhat by Mr. Durston, a spring having a play of some two or three inches was arranged so that it would hold the electrode in connection with the body of the culprit, so that it was impossible to draw away from it.

As the chair was arranged it was demonstrated that the electrodes could be closely applied to the body, that upon the back, however, not having been as thoroughly supplied with the saturating fluid as that upon the head.

The details of the culprit's actions in the trying ordeal to which he was subjected I need not repeat; but merely say that William Kemmler went to his death in a manner which won the admiration and almost love, even if a murderer, of all who beheld him, and demonstrated the untruthfulness of the reports of certain newspapers, which had been circulated about him. However, had he been a powerful, strong individual and objected, there would have been no uncertainty about the carrying out of the penalty. Once strapped in the chair the most powerful man could not have interfered with the purpose of the law.

In the audience, composed of some 24 or 25 gentlemen, there were physicians accustomed to sights associated with death. There were others who were incapable of witnessing even the culprit in his chair without fainting; also some interested in giving to the world as sensational an account of the occurrence as was possible. The newspapers took the opportunity to make a bonanza out of the execution.

The events occurring after the warden had bid good-bye to the prisoner, and given the order to turn the fatal switch, took place. According to the testimony of those in control of the apparatus, the voltage that was expected to be used was not obtained when the first shock was given, and the impression still exists that William Kemmler did not receive the full voltage of the dynamo. However, thanks to the method

of applying the electrodes to the body, on the application of the current, death, in my opinion, was instantaneous.

Mr. Edison objects to the location of the electrodes; his information must have been taken from newspapers. He says the arms, hands, and fingers are full of blood and the current should have been forced through them. How about the canaliculæ and lacunæ of bone? Do they not contain blood? and in many cases the vascularity will compare closely with that of the softer tissues. In life, bone presents, through its vascularity, these innumerable channels filled with (saline) blood, a very fair conducting medium. The question of paralysis of the psychical centres of the brain, which is obtained by the location of the electrodes as in the Kemmler Chair is of vastly more importance than to pass the current through the body with the positive uncertainty of the interference with consciousness, which might ensue if the current were passed through the arms. The difference, if any, in resistance is a factor of no consequence in electric execution.

In the case of Kemmler, the head electrode was filled with the potash solution by myself, and through the spring arrangement, which secured it in place and the immovability of the culprit, there was at least one inch in depth of fluid covering the electrode and confined within its rubber cap. In other words, there was no leakage of fluid from this electrode; how interestingly does this answer the question as to the contortions of the body which our newspapers inflicted on the public. "The truth will out." How did I know the electrode did not leak? I removed it myself some 20 minutes after the current was turned off and the fluid poured down over the head. In this electrode the hair of one edge was merely singed where an arc had been formed; it was not burned to any extent, nor anywhere to the scalp.

There was no question of imperfect contact raised here. The electrode on spine did not fit as tightly or hold the fluid so securely, but even then it did its work, but after the third application of the current dried up the saturated sponge which burned away—only at one edge—allowing the brass plate to touch the skin at this point only. A burn, of course, resulted, but Kemmler was a corpse some time before the second application of the current. Will any one question, even if they do not desire to admit, that Kemmler died in the first 20 seconds, that he was not dead at this time, 100 seconds after first application of current? Dead without physical suffering also? This is the truthful statement of the result of the first electro-execution by one who, during its enactment, was from two to six feet distant from the culprit.

The true history of the first electro-execution should read thus: Current applied, unconsciousness, death immediately resulted; current kept on about 10 seconds—too short a time.

Within 20 seconds of first application of current I could detect no pulse at wrist. Shortly afterward two or three slight movements of chest took place. As to their import see Dr. Tatum's results on dogs, viz: "In 21 out of 23 dogs killed by the application of electricity, effective respiration survived the final heart arrest. Fair inspirations were recorded in several cases as long as 4 or 5 minutes after the dose, which lasted only one second, but after which the heart had not executed a single beat that could be detected. My own demonstrations

prove to be so—as in the second dog operated on the heart ceased beating instantly, but attempts at respiration were made.”

This is why I disagree with Dr. Shrady as to possibility of resuscitation of Kemmler at this time. (See also testimony, 3777, Kemmler enquiry.) There is plenty of evidence to show that respiration following heart arrest has been kept up in individuals subjected to powerful electric stroke for some time, where resuscitation was impossible and the heart had ceased to beat. However, the current was reapplied within 70 seconds. As might be expected, when its influence reached the muscular coats of stomach, a contraction took place, causing a small amount of mucus to ooze forth from the mouth (not fly all over the room, as one paper puts it). This is a good indication of death also. One hundred seconds had now elapsed *at farthest* since the application of the first current. But Kemmler was dead at the first application of current, and with not one iota of feeling, as I stated at the time.

This first electro-execution has demonstrated the positive truthfulness of all that has been claimed by its advocates. Under a voltage much below that recommended, the culprit has been instantly ushered into eternity.

Warden Durston suggested to me, in Buffalo, some weeks before Kemmler's execution, that the electric-execution plant should be in a separate building. A powerful dynamo-engine in one division, death switch in another; lamp-board, volt-meter, especially adapted, with chair, in third room. With this arrangement the Warden and witnesses would never have to record even an attempt at respiration; as at the time of making the circuit the exact voltage, which should be high enough to do its work thoroughly without question, could easily be seen recorded on the meters on the wall.

The Preparation of Vegetable Tissues for Sectioning on the Microtome.*

By A. J. McCLATCHIE,

LINCOLN, NEB.

Vegetable tissues vary so much as to the amount of protoplasm, cellulose, and other substances contained, that the methods used for obtaining good sections from them must vary greatly. I have prepared and sectioned fungi, lichens, the cotyledons, plumules, hypocotyledonary stems, roots, and root-tips of the cucumber, young pine cones, young wheat blades, lilac buds, and bean stems, with varying degrees of success.

Lichens and the young, firm cotyledons of the cucumber could be dehydrated, and permeated with paraffine much more rapidly than young meristemic tissue, or tissue composed largely of cellulose and water. The former may be placed in 50 per cent., 75 per cent., 90 per cent., and 100 per cent. alcohol, chloroform, chloroform and paraffine, and finally in paraffine at a temperature of 55° C., remaining in each from two to twelve hours, and good results will be obtained. But the meristemic and the thin-walled watery tissue must be treated differently

* From the *American Naturalist*, July, 1890.

or the tissue will come through very much shrunken and distorted, worthless biologically.

I have had the most success following the method described by Dr. J. W. Moll, in the *Botanical Gazette* for January, 1888. I have obtained good sections from all the material that I have treated in this way. I used a 1 per cent. solution of chromic acid and 20 per cent., 35 per cent., 50 per cent., 75 per cent., and 90 per cent. alcohols for dehydrating. The chromic acid seems to fix the protoplasm, and macerate the cellulose, allowing the alcohols to pass more freely. I allowed the specimens to remain in the several per cents. of alcohol from two to twenty-four hours, according to their size and texture. As a rule, I found that the more gradually the specimens were dehydrated the better. From absolute alcohol, the specimens were placed in a solution of equal parts turpentine and paraffine. The solution containing the specimens was then raised gradually from a temperature of 20° + C. to about 45° C. They were then placed in melted paraffine, kept as nearly at 50° C. as possible. Small specimens will be permeated in one or two hours, but large specimens require from four to six hours.

From the 75 per cent. alcohol I placed the specimens in a stain. The stains I tried were alum cochineal, hæmatoxylin, fuchsin, methyl green, methyl blue, methyl violet, and ammonia carmine. I found alum cochineal a good stain for fungi, plumules, stems, roots, and root-tips, but it would not penetrate the cucumber cotyledons. Fuchsin would penetrate anything I tried; but as it is soluble in alcohol it is necessary to overstain the specimens, and then allow the coloring to come out until it is about right. Hæmatoxylin stained all the tissue that I tried except the young cucumber cotyledons. This stain gives large specimens a dark blue color on the outside, and a purplish pink color on the interior. The nuclei and the cell walls are brought out clearly. I did not have good success with the methyl colors, as they were easily dissolved out by the alcohol.

If specimens have not taken sufficient color, or if the alcohol has removed too much of the color, sections can be stained upon the slide, after they are cut. Any stain can be used, but none that I tried differentiated the parts sufficiently. Fuchsin will give enough color in a few seconds. The sections must stand in hæmatoxylin from two to ten minutes, and in alum cochineal from ten to twenty minutes. If it is intended to stain upon the slide, an alum fixative will be found better than collodion.

I heated the slides in the gas-flame to melt the paraffine, and poured on turpentine to wash it out. The specimens were then mounted in balsam dissolved in chloroform. Air bubbles that appear when sections are first mounted, will disappear after the slides stand a few hours. If the razor or knife used for cutting is very sharp, small specimens may be cut 1-2500 or even 1-5000 of an inch in thickness. But larger specimens cannot be cut more than 1-600 to 1-1500 of an inch thick without crowding the tissues together, and giving them the appearance of being shrunken.

CORRECTION.—The article in our last issue, by Dr. Whelpley, on the use of the microscope in pharmacy, should have been credited to the Druggists' Circular.

Microscopical Soirée of the New Britain Scientific Association.

The Fifth Microscopical Soirée of the New Britain Scientific Association was held in the building of the Young Men's Christian Association on the evening of June 12. In connection with this were exhibited a large number of pictures by the Photographic Section of this Association.

By Rev. J. F. Stidham, with Zentmayer's Histological: Circulation in plants, pond life; with Bausch & Lomb's Harvard: Varieties in pollen, &c.

By Rev. James Stoddard, with Grunow: Cluster-cup fungus, myxomycetes (*Trichea chrysosperma*); fern leaf (*Dicksonia squamosa*).

By Prof. J. H. Peck, with French: Foraminifera from China Sea seeds (*Epipactis palustris*), (*Orthocarpus*); with Bausch & Lomb's Investigator: Hair of mouse, hair of red Virginia deer, down from humble bee.

By Frank Rollins, with Zentmayer's Histological: Ovipositor of saw fly, spines of star fish, skin of dog fish.

By M. S. Wiard, with Bausch & Lomb's student: Rosette, 240 diatoms, etc., human skin from sole of foot, tongue of cat; with Bausch & Lomb's Library, Improved: Seeds (*Solidago latifolia*), eel grass, mouse-ear chickweed; with Bausch & Lomb's Library: Gold sand, oxide of zinc, mineral, sphalerite, and galenite.

By Miss L. C. Catlin, with Bausch & Lomb's Universal: Vase and bouquet made of butter-fly scales and diatoms, Japanese sketch made of butter-fly scales, sand from Greenland; with Bausch & Lomb's Family: Section of human bone, human scalp, tongue of dog.

By Miss E. E. Carlisle, with Bausch & Lomb's Biological: Cuticle of equisetum, spiral tissue in castor oil plant, leaf of fern (double stained); with Bausch & Lomb's Student: Peristomes of moss (*Aulacomnion*, *Barbula*, *Leucobrium*).

By Geo. P. Phenix, with Beck's New National (polarized light): Stearic acid, sulphate of cadmium, sand from Aiken, S. C.; with Bausch & Lomb's Model: Sections (*Pinus sylvestris*), umbrella plant, root of maize.

By Dr. G. J. Holmes, with Bausch & Lomb's Harvard: Human lung showing three stages of pneumonia, kidney of cat, cancer of the lip; with French: Lung of dog, skin of negro showing pigment, liver of pig.

By Joseph Sayers, with Bausch & Lomb's Model: Photograph of London *Times*, section of petiole of limnantherum, scales of eel.

By C. M. Burgess, with Wales' New Working: Wreath made of butterfly scales, mouth of tadpole, head of crane fly.

By E. M. Hulbert, with French, Nachet & Fils: Elytron of diamond beetle, elytron of Brazilian beetle (*Entimus imperialis*), leg of weevil.

By Dr. H. C. Deane, with Bausch & Lomb's model: Circulation of blood in foot of frog. Other varieties of blood.

By J. E. Atkinson, with Acme No. 4: Transverse sections of pine leaves (*Abies magnifica*, *Pinus coulteri*, *Pinus pungens*.)

By F. A. Pelton, with Bausch & Lomb's Family: Photograph (Declaration of Independence), 7,850 letters in seven ten-thousandths of a

square inch, Lord's prayer engraved on glass; photograph (Happy as a King).

By W. A. House, with Bausch & Lomb's Student: Type slide of 56 diatoms; diatoms from Puget Sound; diatoms, *Arachnoidiscus* Ehr. in situ.

By A. N. Lewis, with Wales' New Working: Living objects in water.

By W. R. Stone, with Bausch & Lomb's Investigator: Living objects in water.

MEDICAL MICROSCOPY.

By F. BLANCHARD, M. D.,

WASHINGTON, D. C.

It was Diphtheria that killed them, in Montmorency and Otsego counties.—Dr. Henry B. Baker, of the Michigan State Board of Health, says:

The outbreak of dangerous disease which has prevailed in Otsego and Montmorency counties since last spring, and which local physicians said was not diphtheria, and permitted two of the corpses to be sent to Lapeer county, where a case of diphtheria occurred in a person who viewed the remains, has been investigated by the State Board of Health, the investigation having been requested by a union meeting of the boards of health of three townships in those counties. Prof. Vaughan, of the University, a member of the State Board of Health, went and made the investigation. He has also made bacteriological examination of the membrane from the throats of two of the patients, and has found and propagated the micro-organisms which are believed to cause diphtheria. This species of micro-organism is known as Löffler's bacillus. Prof. Vaughan says: "The bacilli have been compared with the Löffler bacillus, which I had obtained in the laboratory of Dr. Koch, at Berlin, and the identity of the two cannot be questioned." He reports the disease to be unmistakably diphtheria, as proved by symptoms, physical signs, throat paralysis, etc.; and the diagnosis is sustained by the bacteriological examination. It is now hoped and expected that the local authorities will take thorough measures and stamp out the disease.

Brain grafting.—Dr. W. G. Thompson, of New York, has been experimenting in a new field, that of brain grafting. His observations are recorded in the *N. Y. Med. Jour.* for June 28, 1890. His most striking and successful experiment consisted in grafting a portion of a cat's brain, taken from the occipital region, into the corresponding part of a dog's brain. The dog was killed at the end of seven weeks, and the transported portion of the cat's brain was found firmly united to the dog's brain, the *pia mater* being intact.

A Hint for Facilitating the Microscopical Examination of Urine.—Dr. M. Wendringer advises that the urine be mixed with from a fifth to a third of its bulk of a nearly saturated solution of borax and boracic acid.

To prepare the solution, mix twelve parts of powdered borax with one hundred parts of hot water, and then add a similar amount of boracic acid, stirring the mixture well. Filter while hot. The addition of this solution to urine keeps the urates in solution and prevents

fermentation, while no destructive effect is exercised upon casts or epithelial elements. Moreover, the organic elements collect very quickly at the bottom of the glass.—*Lancet*.

Local Infection with Tubercle Bacillus.—Dr. Gutzmann, of St. Petersburg, made in February, a *post mortem* examination of a body dead of miliary tuberculosis, and, in removing the lungs, in some way injured the root of his finger-nail. After the dissection he felt a pricking sensation in the tip of his finger, but could discover no wound. Nothing more was noticed in the finger till the 20th of March, when it began to pain him, and soon a small abscess was found at the root of the nail. From this abscess pus was taken, spread on a cover-glass, and colored after Erlich's method. Upon examination three tubercle bacilli were found. The wound was thoroughly scratched out and disinfected. Lymphadenitis did not show itself, nor has there been any rise in temperature.—*Jour. Am. Med. Association*, July 19, 1890.

Proportion of White-Blood Corpuscles.—Seventy-two observations made by Remecke, of Halle, gave an average of 1 white-blood corpuscle to 720 red, though variations as great as 1 to 500, or 1 to 1,000, may be normal, and often occur in healthy individuals.—*Fortsch. d. Med.*, vii, 1889.

Definitions.—Antisepsis = fighting microbes. Asepsis = having nothing to do with microbes.

BACTERIOLOGY.

A Simplified Method for Discovering Koch's Bacillus in the Sputum.—Dr. E. Dineur proposes a method which in his hands has yielded excellent results. He places a few drops of the sputum upon a watch-glass, adds first 2 or 3 drops of a concentrated alcoholic solution of fuchsin, and then by means of a glass rod a drop of carbolic glycerine (1 part carbolic acid to 4 of glycerine). The mass is then well stirred. The mixture is then exposed for a few minutes to a temperature of 80° to 100° C., the sputum becoming appreciably thickened thereby. By means of a needle a portion as large as a pin's head is placed upon the slide, together with a drop of pure or diluted (1 to 1) glycerine, and the cover-glass is then applied. At the edge of the latter he places a drop of diluted (1 to 5) sulphuric acid, watching through the microscope the effect produced upon the preparation. "The various morphological substances, the white-blood corpuscles, epithelial cells, and bacteria, gradually grow pale and disappear; the bacillus alone persists a sufficiently long time, and appears stained a beautiful red upon a colorless field." In this method the author employs the Abbe condenser.—*Cent. für Bak. und Parasitenkunde*.

MICROSCOPICAL SOCIETIES.

SAN FRANCISCO, CAL.,—WM. E. LOY, *Sec'y*.

July 23, 1890.—As many members were away on vacation, the attendance was light. The cabinet was enriched by contributions from

Jacob Z. Davis, of the State Mining Bureau. These consisted of diatomaceous earth from Redondo Beach, Los Angeles county, accompanied by a list of the different species of diatoms it contained; and a piece of limestone from Santa Margarita, San Luis Obispo county, abounding in fossil forms of foraminifera. The donation also included a mounted microscopical section of this limestone, which showed the forms to good advantage.

J. G. Clark exhibited a quantity of statoblasts of *Plumatella*, which he found floating in large quantities in the dish after the polyps had died. These statoblasts, or winter eggs, are only extruded after the death of the animal, and their preservation serves to perpetuate the species against frost and drought.

The President, Prof. Wickson, read a paper on "The Bed-bug Hunter." Of the groups of *Hemiptera* which subsist on animal juices, he said, some attack mankind only in self-defence; others seem to relish human blood enough to seek it occasionally, while others still make it the chief means of support. The hemipters which seek human blood as a sort of change from their usual diet of insect blood, include a formidable insect, black, with red markings, and about an inch in length, which sometimes invades human couches and is called the "big bed-bug" (*Conorhinus sanguisugus*). The remaining class, which uses a most painful and poisonous piercer upon human flesh when disturbed, is the "bed-bug hunter," which has been known from early times and has usually been called by entomologists *Reduvius personatus*, but is now named *Opsicætus personatus*. This insect, which is three-fifths to four-fifths of an inch long, invests human habitations in search of the common bed-bug, and is, therefore, called the "bed-bug hunter," but it attacks flies and other insects.

The specimen shown by Professor Wickson was received a few days ago from a gentleman in San Joaquin county, who wrote that he found the bug in his bed after it had bitten his wife three times. The same lady had been bitten twice before at different parts of the county within the past two years, and the gentleman wrote that others in their neighborhood had also been bitten. The effects of the bite cause much discomfort, accompanied by intense itching and burning in the palms of the hands and soles of the feet, gradually extending over the whole body.

Dr. LeConte, in writing of this insect, states that when caught or unskilfully handled it always stings. In this case the pain is almost equal to the bite of the snake, and the swelling and irritation which result from it will sometimes last for a week. In very weak and irritable constitutions it may even prove fatal.

It would seem from the record given of the lady in San Joaquin county, that this insect hardly waits to be "caught or unskilfully handled," but either attacks on his own account or receives the unconscious movements of a sleeping person as interfering with his mission of hunting bed-bugs; or, possibly, the experience related may go to show that the insect relishes human blood from original sources as a change from the juice of the bed-bug. In any event, it is certain the house-wife would prefer to hunt bed-bugs without the aid of this dangerous and repulsive insect, whose bite produces such discomfort.

NOTICES OF BOOKS.

Physiognomy and Expression. By Paolo Mantegazza. Humboldt Publishing Co., 28 Lafayette Place, New York.

Professor Mantegazza is director of the National Museum of Anthropology, Florence; president of the Italian Society of Anthropology, a leading anthropologist of Italy, and his work has been already translated into several European languages. Taking up the study of expression where it was left by Darwin, he has treated the subject in a style that is at once popular and scientific. He has endeavored to distinguish observed facts from mere opinion or imagination, and he has given definiteness and coherence to the many new facts already collected.

The ancients, from Cleanthes up, believed that they could recognize dispositions from the looks. Lavater, who was a physician, a naturalist, and, above all, an enthusiast, first gave something of a rational form to physiognomy. What the volume proposes is, "to restore to anthropology and to psychology that which belongs to it by right, and to make known the positive documents which we possess to-day on the human countenance and on expression."

The Quintessence of Socialism. By Prof. A. Schaffle. Translated by Bernard Bosanquet. Humboldt Publishing Co., New York. Paper, 15 cents.

This is from the pen of one holding high rank among the economists of Germany as well as in the political councils of the empire of the Hapsburgs. What we need at the present time is an accurate knowledge of what Socialism really is, for there is no gainsaying the fact that it is a mighty movement.

Darwinism and Politics. By David G. Ritchie, M. A. *Administrative Nihilism.* By Prof. Thomas Henry Huxley. Humboldt Publishing Co., New York. Paper, 15 cents.

Mr. Ritchie contends that the phrase "survival of the fittest" is very apt to mislead, for it suggests the fittest or best in every sense, or in the highest sense, whereas it only means, as Professor Huxley has pointed out, "those best fitted to cope with their circumstances."

"Administrative Nihilism" fits in with the preceding essay. The two form a very interesting number.

Economy Notes.—Miss M. A. Booth says: These are the days when microscope stands suffer from perspiring fingers. It is a good plan to keep a second-hand stand for the thousand and one rough examinations which collectors are making at this season.

A little rack box for holding slides may be made as follows: Procure or make a box $3\frac{1}{4}$ inches in width and $1\frac{1}{4}$ inches in depth. Smear the inside of the two sides with glue. Cut little sticks an inch long from the tops of matches and attach them at intervals of slightly more than the thickness of a slide, and you have a rack box capable of a good deal of service. Covering boxes with cloth (drilling) adds much to their strength.

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The 13th Annual Meeting of the American Society of Microscopists.

By ROBERT W. SMILEY,

WASHINGTON, D. C.

It was the original intention of this Society to hold its thirteenth annual meeting in Louisville, Ky., but owing to the calamity which befell that city last spring it was decided to hold the convention in Detroit. The local committee, with Hon. L. L. Barbour as chairman, and Dr. W. P. Manton, F. R. M. S., secretary, made every effort to extend to the microscopists a hearty welcome to the "City of the Straits." The High School building and the Princess Rink were both placed at the disposal of the Society for meetings and exhibitions. The Hotel Normandie, because of its convenient location and other desirable features, was selected as the headquarters.

TUESDAY MORNING.

The opening session was held in the High School building, Tuesday, August 12, at 10 A. M., with President George E. Fell, of Buffalo, N. Y., in the chair. Rev. Dr. Moffatt, of Washington, Pa., made the opening prayer. Acting Mayor Stephen A. Griggs spoke enthusiastically of Detroit and its beautiful environment of lake and river. He wished that every member of the Society would consider himself as a friend in a friendly city. He spoke of the fishing and other privileges on the islands, and hoped that the members would enjoy themselves to the highest.

Dr. Fell made an appropriate response. He declared that the objects of the organization were purely scientific, and while the members no doubt heartily appreciated the hospitality extended, they would confine themselves strictly to business. Dr. Fell also spoke of the formation of the Society 13 years ago at Indianapolis; he said that it differed from most societies in that no regular business is transacted at its meet-

ings, the membership is decidedly limited, and it is a work of love. He considered the representation a very fair one for the opening meeting.

Hon. Levi L. Barbour, chairman of the local committee, spoke in regard to the outing Friday and said that none but members would be permitted to go.

The election of new members, approved by the executive committee, included the following:—H. D. Geddings, Key West, Fla.; Albert T. Lytle, Buffalo; A. Wilson Dods, M. D., Fredonia, N. Y.; Walter Storrs Bigelow, Buffalo; H. B. Murray, M. D., Tonawanda, N. Y.; Charles C. Faris, St. Louis; Frederick C. Leher, M. D., Louisville; Lawrence A. Harding, Fergus Falls, Minn.; Henry H. Doubleday, Washington, D. C.; Arthur F. Bartges, Akron, O.; John A. Cutter, M. D., New York; Augustus C. Gruhlke, Waterloo, Ind.; Mason B. Thomas, Ithaca, N. Y.; Williard W. Rowlee, Ithaca, N. Y.; William J. Gillett, M. D., Toledo, O.; Thomas Kennedy, New Brighton, Pa.; R. A. Fish, Ithaca; Grant S. Hopkins, Ithaca; Thomas B. Spence, Ithaca; Frank A. Rogers, M. D., Brewster, Mass.; J. P. Pfanner, Buffalo; E. J. Schanfelberger, M. D., Hastings, Neb.; William H. Sylvester, M. D., Natick, Mass.; George H. McCausey, Janesville, Wis.; L. C. A. Last, Moberly, Mo.; Robert Reyburn, Washington, D. C.; Thomas H. Urquhart, M. D., Hastings, Neb.; James W. Hartigan, Morgantown, W. Va.; Walter N. Sherman, M. D., Merced, Cal.; James Alexander Close, M. B., Summerfield, Ill.; J. M. Yznaga, Washington, D. C.; William R. Chittick, M. D., Detroit; Frank Davis, Belleville, Ill.; H. M. Whelpley, St. Louis; George W. Rice, Detroit; Charles Willig, Jr., New York; Lyman L. Deck, M. D., Salamanca, N. Y.; Edmund W. Weis, M. D., Ottawa, Ill.

Prof. Burrill, of Champaign, Ill., said that two deaths had occurred during the past year—Dr. Newcomber, of Indianapolis, a charter member, and Mr. Eugene Pinckney, of Dixon, Ill.

The first paper on "The Binocular Microscope of the Seventeenth Century," by Chas. E. West, M. D., of Brooklyn, N. Y., was read by title only. The paper by Mr. W. H. Walmsley on "A Handy Photo-Micrographic Camera," was also read by title only.

Dr. Lyman Deck, of Salamanca, N. Y., read an interesting paper on "Resolution of Amphipleura by Central Light." This paper caused considerable discussion among the members.

The paper by Mr. C. M. Vorce, of Cleveland, Ohio, on "A New Daphnella," was read by title.

Prof. M. D. Ewell, of Chicago, Ill., then read an interesting paper on "The Microscope and Camera in the Detection of Forgery." Prof. Ewell stated that the common law prohibits the introduction into a case of writing not already in evidence for the purpose of comparison with the forged document. He thought the laws should permit genuine writing to be put in as evidence, and New York, Wisconsin, and Minnesota have already taken action in the matter. Forgery may be committed by erasures or additions, or by copying the entire writing by tracing or copying. Composite photography had been suggested to identify writing, and he cited several other methods. He held that in signatures exactly alike there is fraud, for no person writes the same twice. The erasures, alterations, and other signs are laid bare by the

microscope. In Chicago recently the court refused to probate the alleged will of Louisa A. Jerome because the signature was shown to be a forgery beyond a doubt. Bromide enlargements made of an actual signature and the forgery were shown, and the differences in style and writing were plain. Prof. Ewell exhibited these enlargements, and the unnatural stops of the pen and shading to fill out the letters were easily distinguished.

Mr. G. S. Hopkins, of Cornell University, read a paper on "The Structure of the Stomach of *Amia calva*."

The last paper of the forenoon was read by W. W. Rowlee, of Ithaca, N. Y., on "Imbedding and Sectioning Mature Seeds by the Paraffin Method."

The following members signed the roll as present: George E. Fell, of Buffalo; T. J. Burrill, of Champaign, Ill.; C. C. Mellor, of Pittsburg; W. P. Manton, F. W. Mann, Albert Landsbery, George W. Rice, and E. L. Shurly, all of Detroit. A. C. Gruhlke and Edward Bausch, of Rochester; A. F. Bartges and V. A. Latham, of Ann Arbor; G. S. Woolman, of New York; W. H. Seaman, of Washington; J. D. Cox, of Cincinnati; W. J. Prentice, J. O. Stillson, of Indianapolis, Ind.; John A. Miller, of Buffalo; M. B. Thomas, of Ithaca; Stuart H. Perry, of Pontiac; W. W. Rowlee, of Ithaca; Simon H. Gage, of Ithaca; J. J. B. Hatfield, of Indianapolis; Ira W. Lewis, of Dixon, Ill.; A. C. Mercer, of Syracuse; E. W. Claypole, of Akron, Ohio; Grant S. Hopkins, of Ithaca; D. S. Kellicott, of Columbus; F. W. Kuhne and wife, of Fort Wayne; Lyman Deck, of Salamanca, N. Y.; H. G. Wales, of Philadelphia, and E. H. Griffith, of Fairport, N. Y.

TUESDAY AFTERNOON.

The session was opened with a discussion on the "Proposed Standing Committee on Medico-Legal Microscopy," by Prof. Ewell, of Chicago. The Professor began the discussion by declaring that the microscope was by no means the simple instrument usually imagined. On the contrary he stated that it was an exceedingly difficult instrument to handle. Some of the pointed stories about the microscope are the strongest points in favor of a medico-legal committee, as this would have a tendency to stop the circulation of stories exaggerating the powers of the microscope. He called attention to an article in a scientific paper telling how the brain-matter found in a Chicago sewer was identified as coming from Dr. Cronin's head. No one had previously heard of Dr. Cronin's brains being exposed until the autopsy. This Dr. Ewell deprecated in the highest degree. To assume for the microscope a position of infallibility, from a medical stand-point, is an absurdity, and goes a long way toward injuring the general standard of the profession.

Dr. Frank L. James, Prof. Seaman, Mr. H. L. Tolman, Dr. Stillson, and Prof. Claypole were in favor of such a committee to correct these wrongs. Newspapers have often spoken about the identification of blood by aid of the microscope, but the best microscopists know that they cannot positively tell human blood. They can tell the difference between the blood of amphibians, mammalia, and fowls. They were of the opinion that the committee would do a very great work, if it could curb the enthusiasm of those who over-estimate the field of the micro-

scope. Courts should be given a standard by which the power of the microscope can be judged.

When the discussion was finished the President appointed Professors Ewell, Seaman, and Claypole, Mr. Tolman and Dr. Stillson as a committee to map out the work of a standing committee on this branch of microscopy.

On account of the absence of Dr. H. M. Whelpley his paper on "The Application of Microscopy to Pharmacy" was read by title.

The next paper was by Prof. T. J. Burrill, on "Microscope Objectives." The paper was very technical throughout. A number of photographs were distributed illustrating some of the points in the address. A general discussion followed, participated in by Prof. Miller, Prof. Gage, Prof. Tolman, Dr. McIntosh, Prof. Ewell, Prof. Kellicott, and Gen. J. D. Cox.

A paper by Mr. C. M. Vorce, of Cleveland, Ohio, on "Additional Notes on Gomphogaster," was read only by title.

"Some Methods of Treating Nerve Tissue," a paper by Dr. Wm. C. Krauss, of Ithaca, N. Y., was read by Prof. Simon H. Gage.

This paper causing no discussion, the next paper on the programme, entitled, "A Review of Some of the Medico-Legal Questions Involved in the Cronin Case," was read by Prof. Ewell. He first took up the subject of hair, the identification of which he had previously imagined to be easy enough, but his own experience had convinced him that such was not the case. In a majority of human hairs the medulla cannot be made out and the cortex alone cannot be distinguished from any other. There are many dogs' hairs, which have the characteristics of human hair. "When I gave testimony to that effect in the Cronin case," said the professor, "they said I was an expert at swearing, and that was all. Well, I have collected the hair of 150 different kinds of dogs that were at a bench show, and have mounted many of the kinds. I will give a premium to any one who distinguishes which is the man's and which is the dog's hair." The speaker said, of course, he did not mean all dogs' hair, but a man was overstepping the bounds when he identified hair as being from the human being. There are three methods of identifying human blood—chemical, micro-spectroscopic, and micro-metric. He said it was possible to identify mammalian blood, but not to distinguish human blood from other mammalian blood. Many errors are likely to arise in the matter of the measurements of blood corpuscles, both on account of the uncertainty of the standards of measurements, and from the condition of the corpuscle itself. A difficulty also arises in determining the probability of restoring the corpuscle to its original shape. One cannot know that the corpuscle has been restored.

In the discussion which followed, Dr. McIntosh, and Messrs. Gilbert, Miller, and Tolman participated.

Dr. Miller, of Buffalo, announced that he had a specimen of blood taken from Kemmler's heart Sunday, and he found the corpuscles with an apparent rupture on the side of them. President Fell said that Dr. McIntosh, who has the only slide with blood taken from the brain of Kemmler, would exhibit it by means of a spectroscope.

The paper on "The Rotifer of Central Michigan," by Prof. Kellicott, was read only by title.

The last paper of the afternoon was then read by Prof. Gage, on "The Transition from Columnar to Stratified Epithelium," and with its discussion the session closed.

TUESDAY EVENING.

In the evening a *conversazione* was held in the hall on the second floor of the Hotel Normandie, and a large number of visiting and local scientists embraced the opportunity of getting acquainted with one another. On a half dozen tables were microscopes displaying objects of not only scientific importance, but also of popular interest. The most discussed slides were two containing the blood of William Kemmler, who was electrocuted at Auburn, N. Y. The blood taken from the lower limbs was in its normal condition, but that from the brain was abnormal, the corpuscles being irregular in size, the protoplasm extending through the sides of some, and there were numerous granules mixed in with them.

WEDNESDAY MORNING.

Prof. M. D. Ewell read a report of the committee on medico-legal microscopy. After some discussion, this report was referred to the executive committee. Dr. Manton opened a discussion in regard to the desirability of omitting the working session from this meeting, because of the great number of papers to be read. After a lengthy discussion, in which Professors Burrill, Claypole, Ewell, Gen. Cox, Dr. Fell, and Mr. Tolman participated, it was decided to hold the session in the afternoon, beginning at 2 o'clock. At 3.30 all who desire may adjourn to another room and listen to the reading of papers.

The first paper of the day was on "Some Experiments to Determine the Limit of Vision as Related to the Size of the Object Observed," by Prof. M. D. Ewell. A small square of white paper pasted on a black background was not seen as far as a black square on a white background, contrary to what the professor had supposed.

Ex-Gov. Jacob D. Cox, of Cincinnati, spoke on "Representation of the Society at the World's Fair, Chicago, 1893." The judge said that if the exposition takes the proportions expected there will be an opportunity of getting together the leading scientists of the world, hence this Society should be represented, but how to go about it was the question. Mr. Tolman, of Chicago, delegate from the Illinois Microscopical Association, said they had already been discussing the matter, and were willing to follow any course mapped out. Dr. McIntosh, of Chicago, favored a scientific hall in which scientific lectures could be held and work done, instead of having the ordinary exhibition.

On motion of Prof. Seaman, of Washington, President Fell appointed the following committee to consider the matter: Ex-Gov. Cox, Dr. McIntosh, Prof. Ewell, Mr. Tolman, and Dr. Miller. The committee was given the power to increase its membership.

The next paper was read by Dr. A. Clifford Mercer, of Syracuse, N. Y., "On a Mooted Matter in the Ordinary use of an Eye-piece in Photo-Micrography." This paper was discussed by Gen. Cox, Prof. Burrill, Prof. Claypole, Messrs. Barr, Tolman, and Dr. McIntosh.

The paper by Prof. Kellicott on "Recent Methods of Investigating Microscopic Animals," was withdrawn.

Owing to the absence of Dr. W. J. Lewis, of Hartford, Conn., the proposed new constitution of the Society was not discussed.

A paper entitled "Observations on Mounting," by Dr. R. N. Reynolds, Detroit, seemed to interest the Society very much.

The paper by Dr. Lucien Howe on the "Action of Bacteria on the Conjunctiva of the Rabbit," was read by title only as were also the papers by Dr. Thomas Taylor, of Washington, D. C., on "A New Flash Light in Photography as Applied to Microscopy," "Postal Cards and Vegetable Fibres," and "The Possibilities of the James Cement with many Fine Specimens."

Prof. Simon H. Gage read a paper on "Picric and Chromic Acid for the Rapid Preparation of Tissues for Classes in Histology." This paper was discussed by Drs. James and Mercer, Prof. Claypole and Mr. Tolman.

Dr. Lee H. Smith's "Résumé of the Past Year's Advance in Microscopy," was read by title only.

Before adjourning there was a long discussion on what to do with the reports now in the possession of the Society and the forthcoming annual report which will contain the proceedings of this meeting. These pamphlets are made up of the papers read, also with notes of the discussion and illustrations. The Society has \$3,000 worth on hand, and the whole matter was finally left with the committee on publication with power to act.

The following additional signatures were placed on the register at the close of the morning session: Charles E. Slocum, Defiance, Ohio; J. F. Kempker, Missouri Valley, Iowa; Charles G. Milnor, Pittsburg; Charles E. Barr, Albion, Mich.; Dr. Mary A. Spink, Indianapolis; Edmund W. Weis, Ottawa, Ill.; Marshall D. Ewell, L. D. McIntosh, A. E. Hess, Chicago; R. N. Reynolds and William R. McLaren, Detroit; George R. Stearns, Buffalo; Anson S. France, Sarnia, Ont.; D. E. Haag, Liberty Centre, Ohio; Frank L. James, St. Louis; A. Clifford Mercer, Syracuse; John Bridge, Detroit; C. D. McLouth, Ypsilanti, Mich; A. M. Bleile and A. Feiel, Columbus, Ohio.

WEDNESDAY AFTERNOON.

The first business of the afternoon was the election of two new members—J. A. Baker, of Wyoming, Ohio, and Edwin A. Strong, Ypsilanti, Mich.

Prof. Gage read a paper on "Uniformity in Tube Length," and Mr. Edward Bausch, of Rochester, N. Y., followed on the same line with "The Full Utilization of the Microscope and Means of Obtaining the Same." The papers were discussed together, and Prof. Gage followed with two more papers—"The Use of the Abbe Camera Lucida," and "Diagrams of the Microscope."

The paper by Prof. W. A. Rogers, of Waterville, Me., "On the Microscope as a Factor in the Production of a Screw 8 Feet in Length," and also that of Mr. Pierre A. Fish, of Ithaca, N. Y., on "The Epithelium of the Brain Cavities," were read by titles only.

With the reading of a paper on "The Ammoniacal Fermentation of Urine," by V. A. Moore, Department of Agriculture, Washington, the session adjourned. Several papers on the day's programme were not touched upon, owing to the absence of authors.

During the afternoon the members left their seats to assemble on the steps of the building and be photographed.

WEDNESDAY EVENING.

There was even a larger attendance at the evening session than during the day, the occasion being the annual address of the President, George E. Fell, M. D., F. R. M. S., of Buffalo. Dr. Fell took a very popular topic for his paper—"The Influence of Electricity on Protoplasm."

The speaker referred to the interest now centred in electricity, and first considered protoplasm as it exists in human nature. Blood taken from the temple of William Kemmler seven minutes after he was pronounced dead shows peculiar changes, the corpuscles being in an abnormal condition. In experiments the resistance to continuous currents has been greater than to the alternating current. The condition of the parts must also be considered, because with dry hands one gives more resistance than when his hands are wet in salt water. In many instances the person taking a strong shock, on recovery says he felt no sensation, the electricity paralyzing the brain. (This paper was published in full in the *Journal* for August.)

THURSDAY MORNING.

In the absence of Prof. Rogers, of Waterville, Me., Prof. Ewell opened the discussion on "Micrometry." It was followed with remarks by Prof. Kellicott, Ex-Gov. Cox, Prof. Burrill, Mr. Woolman, and Dr. Fell, on the advisability of adding more members to the publication committee. A motion to the effect that the past presidents be added prevailed.

Prof. Ewell followed with two papers—"The Effect of Curvature of the Cover-Glass Upon Micrometry," and "Description of Scale (5) Manufactured by the Author in Pursuance of Resolution of A. S. M., adopted in 1889."

The nominating committee was appointed during the morning session as follows: Messrs. Kellicott, Manton, McIntosh, Milnor, Seaman, Woolman, and Mellor.

Gen. Cox read the following papers at the morning session: "Abnormal Forms in the Diatoms and Conclusions Therefrom," "Review of Some of the Generic and Specific Distinctions in the Family *Coscinodisceæ*."

The other papers announced on the programme were, "Fresh-water Rhizopods of Oakland Co., Mich.," by Stuart H. Perry, of Pontiac, Mich., and "Collodion and Imbedding," by Prof. Gage and Mr. G. S. Hopkins.

At 11.30 o'clock the meeting adjourned to an upper room, where Dr. L. D. McIntosh projected several specimens on a large canvas with his solar microscope. The specimens of blood taken from Kemmler were exhibited. The corpuscles taken from the brain were thrown on the canvas at a diameter of about a foot, and their uneven and abnormal condition was plainly shown. The corpuscles taken from the hip were fully an inch and three-eighths in diameter when projected, the comparison revealing the terrible effects of the current on the blood. An excellent photograph of a man taken with the crystalline lens of a calf's

eye was projected, as was also the result of photographing with the composite eye of a beetle.

THURSDAY AFTERNOON—WORKING SESSION.

The forepart of the afternoon session was devoted to the demonstration of practical microscopic work. This session lasted about three hours, and the work done embraced nearly all fields of microscopy, and proved of great interest to the many visitors. The following exhibits were made:

By E. H. Griffith, F. R. M. S.: Miscellaneous work.

By H. Gibbes: Hyaline-fibroid degeneration, flagella on spirillum.

By S. H. Gage: Winkel's marking apparatus for locating minute objects in a preparation.

By M. D. Ewell, M. D., LL.D.: Micrometry.

By Mary A. Spink, M. D.: Sectioning and mounting.

By W. W. Rowlee: Sectioning mature seeds.

By M. B. Thomas: Sectioning mature pistils.

By L. D. McIntosh, M. D.: Attachment for using solar and oxy-hydrogen microscope, with direct or central and oblique illumination and illuminating and projecting opaque objects.

By F. L. James, Ph.D., M. D.: Mounting in glycerine, sharpening microtome knives.

By R. N. Reynolds, M. D.: Sectioning injected material, and mounting diatoms.

By Henry L. Tolman: Methods of preparing slides of blood.

By G. S. Woolman: Method of using a Spencer homogeneous $\frac{1}{10}$ -in. of wide angle in both oblique and central illumination, using a small hand-lamp, $\frac{1}{2}$ -inch wick and edge, at right angle to the mirror for oblique illumination; and using the same lamp, with addition of Abbe condenser, with light direct from the lamp, the edge of the flame in the optical axis of the microscope tube; thus showing that a wide angle objective can be used with facility for both central and oblique illumination, and that it is not necessary in order to obtain good results to use a large wide-wick lamp, and expensive accessory apparatus.

By J. A. Close, M. D.: Injecting tree frog with special apparatus; dissecting with Stephenson's binocular; living *trachinæ* in muscle of white rat; White's improved life slide; Close's tadpole slide; Close's toad plate, and Close's balsam bottle.

The working session, under the able management of Dr. W. P. Manton, of Detroit, proved to be a valuable feature of the meeting, showing as it did the various uses of the microscope and its accessories.

The working session was followed by the reading of papers; and the following were submitted and discussed: "A New Form of Stage Micrometer," by Prof. Ewell; "A New Microscope," by Dr. W. H. Seaman; "Microscopical Study of the Choroid Plexus," by Dr. Mary A. Spink; "The Celloidin Method in Botany," by M. B. Thomas.

The paper by Thomas B. Spence, of Ithaca, N. Y., on the "Comparative Structure of the External and Middle Ear of the Cat" was read by title only.

THURSDAY EVENING—THE SOIREE.

The notable feature of the meeting was the microscopic exhibit given for the benefit of the general public. At 8 o'clock the microscopical

soirée was in successful progress. The illuminated building presented a fine appearance from without. Inside it was filled with light and life. It was estimated that between 3,000 and 4,000 people were present during the evening.

Four benches extended the length of the rink and every yard there was a microscope for which a lamp furnished light. In all there were over 175 microscopes, and the people were compelled to pass in one direction around each bench.

Most of the objects chosen for exhibition were those which would best serve to engage and please the average visitor's attention rather than those of the most particular scientific interest. Among them were exquisite crystals of precious stones and metals, alloys, disease growths, animal tissues, forms of vegetable and shell life, hair, the parasites of various creatures, anatomical and physiological specimens, bacteria, trichinæ, micro-photographs, Kemmler's blood, gold, hairs of Egyptian mummy, insect eggs, &c.

A few of the more important exhibits were as follows :

By A. W. Allen, with B. & L. : Trichina in pork, parasites of beetle, micro-photograph, and crystals of antipyrine.

By Dr. F. W. Brown, with Beck : Polyzoa.

By Bausch & Lomb Optical Co., with B. & L. : Proboscis of blow fly, circulation of blood in the tail of a fish, diatoms, platinocyanide of magnesium, beetle, butterfly scales, and a spider in amber.

By Dr. W. Chaney, with B. & L. : Human blood.

By E. W. Claypole, B. Sc., with Beck : Onion moulds (*Baryeidea parasitica* on *polyactis fascicularis* and *stysanus*).

By E. A. Deseave, with Beck : Young oyster.

By Dr. Lyman Deck, with B. & L. : Scales of mosquito.

By Prof. M. D. Ewell, with Bulloch's : Micrometers.

By Dr. George E. Fell, with B. & L. : Brazilian butterfly, insect eggs on leaf, head of cysticercus, and blood of Wm. Kemmler.

By Dr. A. Feiel, with Bulloch's : Salicin (polarized).

By Prof. S. H. Gage, Branched muscular fibres.

By Mr. E. H. Griffith, with Griffith club : Diatoms, crystals, and foliage of pure silver.

By Dr. D. E. Haag, with B. & L. : Canary bird's louse.

By A. Kuhlman, with B. & L. : Isthma nervosa, 155 portraits, tails of the June fly, tongue of rat.

By Prof. D. S. Kellicott, with B. & L. : *Medulla oblongata* and cerebellum of kitten.

By Miss V. A. Latham, with Beck's : Double injected human lung.

By Dr. C. Henri Leonard, with Beck : Hair of Egyptian mummy 4,000 years old.

By Dr. L. D. McIntosh, with oxy-hydrogen projection microscope : Photographs of *Amphipectura pellucida*, human spinal cord, bacillus of tuberculosis, anthrax, and swine plague.

By Mr. C. C. Mellor, with McIntosh : Foraminifera.

By Dr. W. P. Manton, with Griffith club : Croton water-bug and ferns.

By C. G. Milnor, with B. & L. : Human lung in health, and arranged diatoms.

By J. W. Queen & Co., with Acme stands : Diatoms, and tongue of house fly.

By G. S. Woolman, with Beck and Acme: Watt's fern leaf gold crystals, tongue of blow fly, diatoms, and butterfly scales.

By J. Zentmayer, with Centennial: Crystals of gold, with army stand, diatoms.

By R. S. Reynolds, with B. & L.: Cider vinegar showing eels.

The blood of murderer Kemmler formed the ghastly subject for an eager crowd of morbid curiosity-seekers. In the biological exhibit there was much interest to be found in the examination of the circulation of the blood in the tail of a fish and the foot of a frog, both live subjects. Beautiful bouquets of flowers were seen in one instrument formed of the tiny scales of butterflies; the hair of an Egyptian mummy was shown in another; micro-photographs representing scenes in cities, animals, pages of text-books abounded; various crystals which are of rare occurrence in mineralogy; parasites of the human flesh; animalcules of fluids and scores of other subjects were shown.

The exhibition lasted two hours, and the wonders of the microscope seemed veritable miracles to some, who for the first time peered through the tube. The local managers are justified in feeling proud over the success of this soirée which rivalled, if anything, that held in Buffalo one year previous. It was said to be the finest public exhibition of microscopical subjects ever given.

FRIDAY MORNING.

In the absence of Mr. C. M. Vorce, of Cleveland, Dr. James opened the discussion on "Fees of Experts with the Microscope." The discussion was quite animated.

The only papers of the day "The Microscopic Identification of Hair," by Prof. Ewell, and "The Cancer Cell," by Dr. L. Young-husband, of Detroit, were read by title.

Prof. Seaman precipitated a discussion by favoring "The advisability of meeting at the same time and place as the American Association for the Advancement of Science." He stated that several of the gentlemen present belonged to both societies, and meeting close together would save time and money. Several motions regarding the matter were offered, and it was left in the hands of the Executive Committee. The report of the committee on tube length was then read and adopted.

Treasurer C. C. Mellor read his report for the year. At this meeting \$340 had been collected, and the cash on hand amounted to \$528.44. Subscriptions to the Spencer and Tolles funds now aggregate \$253.86. The financial aspect of the Society is considered very encouraging.

The report of the Nominating Committee was presented by Mr. Mellor, and the nominees elected unanimously, as follows: President, Dr. F. L. James, of St. Louis; Vice-Presidents, Dr. E. W. Claypole, of Akron, Ohio, and Prof. Marshall D. Ewell, of Chicago; Secretary, Dr. W. H. Seaman, of Washington; Treasurer, C. C. Mellor, of Pittsburg; Executive Committee, Dr. E. L. Shurley, of Detroit, Dr. J. O. Stillson, of Indianapolis, Dr. A. Clifford Mercer, of Syracuse. The Treasurer was given power to appoint a deputy custodian.

After the reading of a paper by Prof. Gage, of Ithaca, on "Form and Endings of Striated Muscular Fibres," the business session adjourned.

MANUFACTURERS' EXHIBITION.

Fine exhibits of microscopes, objectives, accessories, microtomes, mounting instruments and materials, lenses of all descriptions, cabinets for slides, microscopical literature, and mounted objects were made by the following well-known dealers in microscopic supplies:

By Messrs. BAUSCH & LOMB, of Rochester: Microscopes of their own make, together with all microscopical supplies, objectives, microtomes, books, etc.

By Messrs. J. W. QUEEN & Co., of Philadelphia: Microscopes (Acme)—calling especial attention to the easy movement of the coarse adjustment. Slides of anatomical sections and of general interest, books and accessories.

By Dr. L. D. McINTOSH, of Chicago: 5 microscopes, microscopic attachment for use with solar or artificial light for projecting or photographing objects, solar stereopticons, slides, etc.

By Mr. JOSEPH ZENTMAYER, of Philadelphia: Centennial, Army, Histological, and Student stands, objectives, microtomes, nose-pieces, general slides and other supplies. This is the first exhibition that Mr. Zentmayer has made for several years.

By Mr. G. S. WOOLMAN, of New York: Microscopes, object boxes, and many slides illustrating nearly all branches of microscopical mounting, many of which were of a rare character. Noteworthy among them were the histological and dental, many of which were beautifully stained, others that required polarized light. The sections of rock attracted attention, as did also those of insect scales, one of the slides being worth \$25.

FRIDAY AFTERNOON—THE EXCURSION.

In the afternoon the microscopists embarked on a ferryboat at the foot of Woodward avenue and were taken to Parke, Davis & Co.'s laboratory, where they were shown through the establishment and refreshed with "the best medicine made there," as one of the gentlemen put it. Again going aboard the steamer they were taken to the mouth of the St. Clair canal and back to the city. While on the boat votes of thanks were extended the citizens and microscopists of Detroit for the pleasant entertainment afforded, Parke, Davis & Co. for their kindness, the press for full and fair reports of the proceedings, and the retiring officers. The new officers were installed and a splendid lunch served.

The new president, Dr. F. L. James, of St. Louis, is a most excellent man for the position. Eminent not only as a physician and microscopist, he is a good writer, and an editor of the *St. Louis Medical and Surgical Journal*, and also of the *National Druggist*. The meeting which was brought to such a happy close this afternoon was one of the most successful ever held. In speaking of the session, one of the members said: "To be sure the attendance was not as large as at the Buffalo meeting, but the discussions, papers, and exhibits were excellent. We leave Detroit very favorably impressed with its beauty and the liberality of its citizens."

The time and place for next year's meeting will be determined by the executive committee and hereafter announced.

TECHNIQUE.

Hæmatoxylin as a means of ascertaining the Alkalinity or Acidity of Tissues.—Prof. F. Sanfelice has found that the acid or alkaline reaction of tissues may be recognized by staining with Bøhmer's hæmatoxylin (alkaline), or with the author's iodized hæmatoxylin (acid).

In using this method as a test, two principal precautions must be observed: First, it is necessary that the normal reaction of the tissue must not be interfered with, hence reagents such as chromic acid and its salts, Müller's fluid, and Flemming's solution are unsuitable fixatives. The author used chiefly absolute alcohol for hardening and fixing, and also corrosive sublimate, the excess of which must always be carefully extracted with spirit. The second precaution is that the hæmatoxylin solution must have only a feeble reaction.

Among the instances of differential staining obtained by this method it is mentioned by the author that the protoplasm masses in the ovary and testicle of Selachians are colored red when the whole of the tissue is treated with the alkaline solution—a fact which proves that the elements undergoing this form of necrobiosis acquire an acid reaction. Goblet-cells in the intestinal mucosa become colored blue, while the rest of the tissue remains red. Hence the reaction of goblet-cells is alkaline, and this method might be usefully employed to ascertain the reaction of tissues or elements, and their products.—*Journ. de Micrographie*, xiv (1890), pp. 21–22. *J. R. M. S.*, 1890, p. 538.

New Method of Staining Central Nervous System, and its Results.—Prof. P. Flechsig recommends the following method of staining the nerve-cells of the cerebral cortex and their prolongations. By means of it it was shown that the axis-cylinder process was the only prolongation from the cell which was in connection with a nerve-fibre; that the axis-process, which is not at its commencement medullated, divides like a T, *i. e.*, dichotomously at a right angle. In the occipital lobe a trichotomous subdivision was the rule, although frequent subdivision was also remarked. In the neighborhood of the central fissure some axis-fibres did not subdivide.

These results were obtained by hardening pieces in 2 per cent. aqueous solution of chromate of potash, and then making sections not exceeding $\frac{5}{100}$ mm. in thickness.

After soaking in 96 per cent. spirit, the sections are kept for 3 to 8 days in a solution of redwood extract at a temperature of 35° C. The sections having been washed in distilled water are then decolorized in the following manner: Each section is placed in 3 ccm. $\frac{1}{4}$ to $\frac{1}{5}$ per cent. solution of permanganate of potash until the solution has lost its bluish color; it is then immersed in the decolorizer (distilled water 200, oxalic acid 1, hyposulphite of potash 1), until all traces of yellowness have departed from the section.

The redwood solution is made as follows: 1 gram of the pure extract of Japan redwood is dissolved in 10 grams of absolute alcohol, and then diluted with 900 grams of distilled water. To this are added 5 grams of a saturated solution of Glauber's salt and a similar quantity of a saturated solution of tartaric acid.

If this redwood method be combined with Golgi's sublimate staining, the sections, having been stained as above, are placed in a mixture of 20 ccm. absolute alcohol and 5 drops of 1 per cent. solution of chloride of gold and potash, until the sublimate precipitate has become quite black, and the red nerve-fibres have assumed a bluish tone. They are then washed in 10 grams of distilled water, to which 1 drop of a 5 per cent. solution of cyanide of potash has been added, then dehydrated in absolute alcohol, cleared up in oil of lavender, and mounted in balsam.—*Berichte ü. d. Verhandl. K. Sächs. Gesell. Wiss., Leipzig*, 1890, pp. 328–330 (1 pl.). *J. R. M. S.*, 1890, pp. 538.

To Rectify Turpentine for Microscopical Use.—In a quart bottle agitate one pint of common turpentine with four fluid ounces of 98 per cent. alcohol. Decant the turpentine (which will form the lower layer), after standing for two hours, and mix it with one pint of clear water. Agitate, and let stand until the two fluids separate. Decant the turpentine (which this time will form the upper layer), and finally, mix it with an ounce of powdered starch, and filter through paper. A pure, limpid turpentine is the result.—*Charles C. Faris in the Microscope*, June, 1890.

BACTERIOLOGY.

Formation of Nuclei and Spores in Bacteria.—Dr. P. Ernst has, by means of three quite different methods, demonstrated in a number of bacteria a new element—small granules which are most frequently seen when the bacteria are developing with difficulty or are about to sporulate. There is no constancy in the number of these granules, for there may be one or more. They stain blue-black in warm alkaline methylen-blue and cold Bismarck-brown solution. Delafield's hæmatoxylin stains them black-violet, and Platner's nucleus-black blackish.

The author believes he has proved that these granules develop into spores, and therefore calls them *sporogenous granules*. As they did not under some conditions become stained with Neisser's spore-stain, they are to be considered as being actually different from spores, although the predecessors of these. This view is further supported by the fact that hæmatoxylin and Platner's nucleus-black stain the granules but not the spores. In their earlier condition they are easily peptonized (3 hours in solution of pepsin 0.5, HCl 0.2, H₂O 100, but as they become older the greater is their resistance to digestion; and this is complete when they have developed into spores. With methylin-blue and Bismarck-brown the sporogenous granules stain blue-black, the spores blue. All boiling fluids, including pure water, cause their disappearance. The granules are certainly not vacuoles, and do not consist of fat (insoluble in boiling ether), or of starch (do not stain with iodine).—*Zeitschr. f. Hygiene* v. (1888), p. 61; *J. R. M. S.*, 1890, p. 79.

Bacteria-destroying Power of the Blood.—In experimenting on the property of blood-serum devoid of cells as to its power of destroying micro-organisms, Dr. F. Nissen used the blood of dogs and

rabbits. The blood was withdrawn from the carotids and received into sterilized vessels heated up to 35° C., and then defibrinated with sand. In the result it was found that while the various kinds of bacteria did not behave in the same way, yet a great number were found to be quickly destroyed by the blood influence. Of the pathogenic species, which were found to be susceptible to this blood power, were the bacteria of cholera Asiatica, anthrax, typhoid, and pneumonia, and of the Saprophytes, *Coccus aquatilis*, *Bac. acidilactici*, *subtilis*, *Megatherium*. On the other hand, *Staphylococcus aureus*, *albus*, *Streptococcus erysipelatis*, bacilli of fowl cholera, swine plague, *Proteus vulgaris*, *hominis*, *B. fluorescens*, *prodigiosus aquatilis*, and others multiplied with great facility. The power of killing bacteria possessed by the blood is also influenced by certain conditions and reagents; thus, if heated for half an hour to 54° – 56° C., it loses it, as is also the case if allowed to stand for some hours, or if its coagulability be affected as by the intravenous injection of pepton, or by admixture with sulphate of magnesia.

Moreover, the quantity of micro-organisms has great influence on the result, the annihilating influence of the blood being only able to prevail up to a certain extent; when this point is reached the blood becomes quite a perfectly suitable medium for their development.

The author concludes from the foregoing experiments, and also from others made with horse's blood, that the power of the blood to overcome bacteria is to be regarded as a destructive property residing in the plasma, but he does not explain if there be any reason to suppose that there exists a definite separable constituent of the plasma which is capable of producing this effect.—*Zeitschr. f. Hygiene* vi, heft 3; *J. R. M. S.*, 1890, p. 225.

Bacterium phosphorescens.—In discussing the origin and causation of the light emitted by *Bacterium phosphorescens*, Dr. K. Lehmann observes that there are two obvious possibilities to be considered. First, the illumination may be a vital phenomena accompanied by the production of CO_2 , heat, &c. Secondly, it may arise from the oxidation of a photogenous substance excreted by the cells, and resembling the pigment formation of many chromogenous species. This photogen must therefore be very sensitive to chemical reagents. In favor of the former view are the following facts: Cultivations when emitting light always contain illuminant bacteria, and in this condition can always be successfully cultivated. All germicidal media destroy the illumination. Lastly, in correspondence with the great resistance *B. phosphorescens* shows to low temperatures, the illuminative power is preserved at similarly low temperatures. In association with this is to be counted in the fact that while development diminishes with increased temperature, so also does the emission of light.

These facts seem to show that the light emitted by the fungi is always associated with their vitality, and is therefore not reconcilable with a photogenic property unless the latter has ascribed to it all the characteristic of a living plasma.—*Biologisches Centralblatt*, ix, 1889, pp. 479–80.

Nasal Bacteria in Influenza.—Ezra H. Wilson, M. D., read a paper before the Brooklyn Pathological Society, February 13, 1890, in

which he said : This specimen under the microscope is a cover-glass preparation of the nasal secretion in a case of influenza, mounted January 12. I wish, in presenting this slide, to call the attention of members of the Society to the work recently done by Dr. J. Wright, in the laboratory of the College of Physicians and Surgeons, under the direction of Dr. Prudden, in the investigation of nasal bacteria in health. This observer made a most careful series of experiments in examinations, cultivations, and isolations of the different forms of micro-organisms found in the nose in health. The article can be found in the Journal of the American Medical Association, September 21, 1889. I will not quote the entire article, but only the summary.

The *staphylococcus pyogenes* in six cases, *micrococcus flavus decedens* (3), *penicillium glaucum* (1), *micrococcus cereus flavus* (1) *micrococcus tetragenus* (1). I made, during the recent prevalence of influenza, several cover-glass preparations of the nasal secretions, and observed the following :

1. There was a vast increase in the number and variety of micro-organisms over those in health.

2. That this number bore a direct ratio to the severity of the symptoms.

3. That the prevalence of *streptococci* over *staphylococci* was evident, and that a *diplococcus*, probably a *pneumococcus* of Frankel, was very abundant.

4. The presence of a bacillus, looking very much like and probably identical with Koch's bacillus tuberculosis, although not behaving the same with decolorizing agents.

The *micrococcus tetragenus*, or at least a tetrad resembling it, was very frequently found.

I do not claim to be absolutely positive about the identity of any of these micro-organisms, because no cultures were made, and none were isolated ; but one can be reasonably certain of well-known organisms.

In the specimen under the microscope, which is under a one-twelfth oil-immersion lens of Zeiss, you will see the enormous number of micro-organisms. You will see that a large number of them are chain-cocci, and you will see numbers of diplo-cocci. This specimen is really of no special interest, only that it illustrates in a beautiful manner the increase in the number of bacteria, and the method of staining has brought them out fairly well.

I believe, although the only accounts I have seen are in the daily papers, that two observers in Vienna have claimed to have discovered the specific organism of grip ; but this claim has been denied by German bacteriologists, who say the organism claimed as the cause of "grip" is identical with the *pneumococcus* of Frankel.—*Brooklyn Medical Journal*.

MEDICAL MICROSCOPY.

By F. BLANCHARD, M. D.,

WASHINGTON, D. C.

A New Discovery in Blood.—Edington, in a paper on "The Morphology and Development of the Blood" (*Brit. Med. Jour.*), describes a new blood corpuscle, the *albocyte*, from which he claims the

red corpuscles are developed. They are about one-third the diameter of red corpuscles, the larger ones are distinctly discoid, they have nothing whatever to do with fibrin formation, and may even be obtained from blood which has coagulated. This author supposed that these corpuscles were developed within some cell which ruptured and liberated them. He examined an immense number of slides before finding such a cell. He succeeded, however, and looks upon the latter as a mother-cell for which he proposes the name of *matricyte*. As to the period of rupture of these matricytes, Dr. Edington states that very few albocytes are seen in the blood during a fast, but they are noticed very soon after the ingestion of food. The albocytes, as their name indicates, are colorless at first, and probably spherical, they then progressively increase in size and, by the acquirement of hæmoglobin, become mature red corpuscles.

Small Doses.—The *Homœopathic Physician* quotes with glee the following from Dr. Koch's address on "Bacteriology" at the International Medical Congress, in Berlin: "Certain bodies, such as volatile oils, and certain metallic salts, such as nitrate of silver, and preparations of gold, even in very small doses (1 in 1,000,000, and even less), destroy the tubercle bacilli in a very short time."

Medical Alliance in Washington.—The physicians of Washington are organizing a Medical Alliance, the principal object of the organization being to protect the profession against dead-beats—that is to say, those who can pay the doctor, but will not. All schools of medicine are included in the Alliance. Careful provision is made against inflicting any hardship upon the worthy poor.

Dr. G. M. Sternberg is one of the few savants who have set out to discover the microbe of a given disease and did not find it. In 1879 he began this investigation, and he still announces that the result of his research is negative, and that he does not yet know what microbe produces yellow fever. It is a case of rare moral courage.

The Pneumococcus.—From a very instructive paper by J. J. Kinyoun, M. D., in the *Journal American Medical Association* for August 9, 1890, we abstract the following facts concerning the micro-organism of lobar pneumonia. Studied experimentally, it grows best upon agar gelatine and bouillon between 35° and 38° C., with the peculiarity of ceasing to grow in about four days, and dying, if not transplanted to fresh nutrient media within that time. The agent which thus destroys it is its own ptomaine. In the culture of the pneumococcus we simulate the conditions that are present in the buccal cavity. There the ptomaine, as fast as formed, is removed, either by absorption or by solution in the saliva. At ordinary temperatures it lives about three weeks.

In the saliva are found several other bacteria which exert an influence upon the growth of the pneumococcus. This can be shown experimentally; for, if they are planted together in nutrient media, these being kept at blood temperature and transplanted every day upon fresh soil, within a few days the pneumococcus will generally have disappeared. But when cultures of the pneumococcus, inoculated with various other micro-organisms, were subjected to the temperature of freezing, the pneumococcus showed an enormously greater power of survival.

We regret that we cannot reproduce the paper in full.

A Parasitic Amœba, hitherto known to be found only in Russia and Egypt, was found by Dr. Osler, of Baltimore, in the pus from a liver abscess and in the fæces in a case of chronic dysentery. The patient had lived for five years in Panama. The amœbæ had about twelve times the volume of the white blood corpuscle, and were very active in their movements.—*Centralblatt für Bakter. und Parasit.*

The Hydrophobia Bacillus.—At the late annual meeting of the American Neurological Association in Philadelphia, Dr. Richard Mollenhauer exhibited some microscopic specimens taken from a dog which he had succeeded in rendering rabid by inoculation. The germ was a bacillus whose various growth-stages presented a uniform type. In its adult period it was usually found in chains typically made up of four, rarely of three, somewhat more frequently of two, and exceptionally of five links.—*Sanitary Era*.

Sulphurous Disinfection.—Dr. Henry B. Baker writing to E. B. Frazer, M. D., Secretary of the Del. State Board of Health, says:

Your letter acknowledging the receipt of a copy of my letter to Dr. Duffield (giving results of experience of health officers in Michigan, and an account of the experiments by Pasteur, Roux, Dujardin-Beaumetz, and others relative to sulphurous disinfection) is before me. You ask me for further opinion, and refer to the report of the Maine State Board of Health for 1889, page 251, and Dr. Mitchell Prudden's estimate of the want of value of sulphurous disinfection.

There are at least two valid objections to the acceptance of Dr. Prudden's conclusions to which you refer: (1) His experiments dealt with a micro-organism which seems to be different from the one most generally accepted as the probable cause of diphtheria. Therefore he may or may not have been dealing with a micro-organism causing diphtheria. (2) The quantity of sulphur burned; the strength of the sulphurous acid fumes which he employed *is not stated*. It having been proved by actual experience with disease and by other laboratory experimenters (Pasteur, Roux, Dujardin-Beaumetz, Vallin, Legouest, Polli, Pettenkofer, Dougall, Fatio, Pietra Santa) that sulphurous acid gas is *not always* a disinfectant when employed in small proportions, and that it *is* a disinfectant when employed in large proportions, such as result from the burning of three pounds of sulphur to each thousand cubic feet of air-space, no different conclusion should be reached from Doctor Prudden's experiments as published.

You mention that Dr. W. H. Welch of Baltimore, "enters his protest" against disinfection by sulphurous acid gas. I respectfully submit that entering a protest should count for very little in science as against results of actual practical experience in the restriction of diphtheria; it should not even take rank with definite statements of results of laboratory experiments.

Laboratory experiments are very valuable, but they need to be repeated, by the same observer and by other observers, in order to eliminate errors due to accidental and incidental conditions.

It is not easy to make laboratory experiments which shall conform to or correctly represent average conditions in actual outbreaks of disease. That is probably one reason for the discrepancies in laboratory experiments, and for the disagreement of some laboratory experiments

with practical experience with disease. One reason for this last disagreement may be that micro-organisms which, after subjection to a disinfectant, may yet have sufficient vitality to reproduce in a laboratory where *the most favorable conditions are supplied*, could not possibly do so in the human throat, or elsewhere in the human body, because of the well-known power of the fluids of the body to destroy micro-organisms, as proved by Doctor Prudden's and other laboratory experiments following but not confirming Metschnikoff's doctrine of the Phagocytes.

Progress would be easier, more rapid, and the backward and forward movements less frequent if experimenters in laboratories would be more careful in stating the details of their work.

The interpretation of the results of laboratory experiments and the determination of the bearing which they should have upon practical affairs is an extremely difficult work, and one in which there is very great liability to error.

Practical health officers need to employ a *gaseous* disinfectant that shall at once reach all surfaces, ledges, cracks, drawers, and receptacles of dust wherever it may be in a room, that shall permeate all articles sufficiently permeable to admit disease, causing micro-organisms that will not necessitate too much labor in the removal of furniture or other articles, and that shall have power to destroy or sufficiently weaken the vitality of the "germs" of such diseases as diphtheria and scarlet fever, and occasionally small-pox, as they are usually distributed in the sick room, and that shall not destroy family portraits and similar articles. Only two such disinfectants are prominently before us for choice, chlorine and sulphurous acid gas. Of these two, sulphurous acid gas is made in proper quantity, with more certainty and less trouble than is chlorine gas; and, at present, I regard the weight of evidence in its favor as equal to that relative to chlorine gas, concerning which not so much evidence has been published. Practical experience in Michigan proves that by isolation of first cases of diphtheria, and disinfection of premises after death or recovery therefrom, by fumes of burning sulphur, etc., four-fifths of the cases and deaths which would otherwise occur from that disease are prevented. If there is any other method of disinfection or any other procedure that can be shown to reduce the cases and deaths more than the four-fifths and down to less than an average of two and one-third cases and six-tenths of one death to each outbreak, I am exceedingly desirous of knowing what it is. But inasmuch as that is the recent experience in Michigan (outside of the great cities) it does not seem best to give up the methods employed until evidence of a better method is produced.

Meantime I would advise a continuance of sulphurous disinfection for the purposes for which it is applicable and for which it is greatly needed as stated above, *not* including the disinfection of excretions from the patient, for which chlorinated lime or liquid is applicable, nor of bits of diphtheritic membrane, which should be destroyed by fire as should also all rags and everything else not too valuable used about a patient; and all clothing, bed-clothes, etc., that can profitably be boiled should be so treated.

BOYS' DEPARTMENT.**What Shall My Cabinet Be?**

By E. C. HOYT,

MEDINA, OHIO.

Cabinets are made in so many different forms that it is often quite a puzzle to the young microscopist to decide which is the most desirable. The writer, after ten years experience can, perhaps, be of some assistance.

There are many things to be considered in the selection of cabinets, such as fire, moving, looks, convenience, safety of slides (either when exhibiting objects to one's friends, or while lying in a cabinet year after year), facilities for indexing, cataloguing, the exclusion of dust, etc.

In referring to numbers I will use Mr. Woolman's catalogue, as it happens to lie before me. Most other dealers furnish the same styles of cabinets, only varying as to catalogue numbers.

Mr. M. S. Wiard has written a paper and illustrated a very fine cabinet to hold 2,520 slides, made out of a spool-case, which has most of the good features of No. 3817, which only holds 1,000 objects and costs \$70.00. These cabinets are very nice where one is permanently settled, but in case of a fire the result might be disastrous; and if one had to move, even no further than a few blocks in a city, there would be great danger of loss, and to move any considerable distance, one would have to purchase packing boxes and pack each slide carefully in cotton.

The Pillsbury cabinets show more desirable features than any others, perhaps. They are practically dust-proof, the objects lie flat, they may be packed as they are and moved thousands of miles, as my own objects have been, thereby saving the trouble of rearranging with catalogue upon opening. They are very handy, occupy the least possible space. Somehow I always have felt that a \$5.00 or a \$10.00 slide deserved a better home than a 10-cent wooden box, and the labels on the ends of the boxes are altogether too small for 25 names. This may be remedied by a catalogue. In this way, by simply numbering the boxes, any slide may be found in an instant. The whole label is about large enough to show the number and the nature of the objects satisfactorily.

No. 3809 with four doors, holding 200 objects, is a pretty cabinet, but as the objects cannot lie flat, should be used with care. This is also a difficult cabinet to catalogue. It might do for opaque objects so far as the incline goes, but I consider no balsam mount safe in it for any great length of time. It was Dr. Carpenter who said, "All objects should lie flat," and he is good authority.

No. 3809½, holding 200 objects with deep cells, or 400 when slides are placed back to back, is a very good cabinet for natural minerals cemented on to slides, and I have moved mine full without a broken slide, but it catches about all the dust which falls upon the top of the cabinet, and would be very unsuitable for fine slides. Had this defect been foreseen it might very easily have been avoided.

No. 3808, holding 72 objects in 12 trays, is a good cabinet for slides which look nice to the naked eye. They show to good advantage, and

by systematically numbering the trays, that is, have No. 1 at the extreme left end, and No. 12 at the extreme right end of the cabinet as it faces you when opened, etc., you can easily find any number, whether laid in with regard to rotation or not; Nos. 5 and 6 would be nearly the centre, and so on. I have discovered one serious objection, however, to this form. A great many visitors have a curiosity to see the slides *not* under the microscope, and they handle them ruthlessly. Further, it is not adapted to moving, at all.

No. 3805½, those small green boxes, holding 25 or 26 each, with folding covers, are what I have settled down to, after trying all styles. I claim more good points for these than any other cabinet. They require a black walnut box made out of quarter-inch stuff, with open front, to hold six of the green boxes, with a division for each three boxes, just the right width, with about an inch to spare at the top. It costs but a trifle. In this way you have 150 slides in a very convenient shape to handle at any time. Little or no dust gets in to the objects. There is plenty of room for cataloguing, which should be done alphabetically. If you desire to make a change you have only to paste a piece of paper over the old catalogue. Your objects lie flat: they make a neat appearance. You can pack them as they are, and when you come to unpack, you have only to remove the cotton, and with proper labels *the immense amount of work required to keep up your catalogue work is entirely saved for more useful labor*. The inside box should be numbered on the end; the outside on the front. Use your own taste as to the color of the labels and the number of them, only have them uniform. Four labels do very well.

For illustration, on one of my boxes I find, Polar, —, Minerals, — No. 7 — Powers, one inch and half inch.

My labels inside are divided into several columns, one column for the mounter, one for the object, another for the country, another in some case, as in diatoms, for the number of striæ, the number in a group, etc., and, at the extreme right of all, I have placed the value of each slide. Now, supposing I wish to look at a section of serpentine, I do not require any catalogue to tell me it is "Polar Mineral." The boxes arranged alphabetically, no matter how many one has, it is readily found. Upon opening the box the objects being arranged alphabetically I have only to look under the letter "S" to find "Serpentine." Where, as in diatoms, one might have several boxes, they may be divided into "Diatoms—A to C," etc. With this arrangement one need never have over 25 objects on the table at one time. The edges of the slides—all that shows—are not very attractive to a visitor, and therefore your slides are safer, etc., and after experimenting in a variety of ways I have arrived at the conclusion that these little 35-cent cabinets are preferable to all others. Some of my friends have abandoned the more expensive ones after seeing my arrangement.

It seems hardly necessary to again call attention to the importance of slides lying flat. These boxes must stand on end like books in a book-case. I saw a whole collection of fine slides in the office of an experienced microscopist in the city of Detroit, in these very same boxes, but lying upon their edges, as they happened to fit the doctor's secretary in that shape. It may be no harm, therefore, to repeat the warning.

NOTES.

The American Drawing Ink.—This ink, first introduced in 1880, under the name of the “American Drawing Ink,” or the “American India Ink,” has now gone into general use, and is recognized as the leading drawing ink in the United States, having extensively displaced the original stick ink, and superseded all the crude liquid inks previously attempted. It is not a solid ink ground up, but a new native ink, made fluid from the outset; and it will never become gelatinous, thick, or offensive, or deposit carbon, like all so-called “Liquid Inks” with which draughtsmen have been heretofore afflicted. It thus fills a long-felt want. This ink is put up in a special bottle, with a quill for filling the pen and an improved stopper, and is thus ready for instant use.

There are two kinds of black ink, viz: General drawing ink (red label), which is best for tints and washes, for tracings, for Patent Office and photo drawings, and all fine-line work. 2d. Waterproof drawing ink (white label), which is insoluble when dry, and is best for working drawings which have to stand handling, moisture or color washes.

The blue, scarlet, and green drawing inks sell for 25 cents per bottle, the carmine for 35 cents. There is no better ink for making drawings of microscopic objects. They may be obtained from Geo. S. Woolman, New York.

Dead *Uroglena volvox*.—During the season 1889 the cities of Middletown and Meriden, Conn., had their reservoir water rendered almost unusable by the development in it of a very strong fish-like odor. An examination showed that this was due to the presence of an abundance of *Uroglena volvox*, Ehr. While alive, the organism produced no effect upon the taste or odor of the water; but, in passing through the mains, became entirely decomposed with immediately deleterious results.—*S. W. Williston, in The Microscope*, March, 1890.

The Youth's Companion for September 11, 1890, has a bright paper on The Microscope at the Pond-Side, by Stephen Helm. *Microsterias denticulata*, *Closterium lunula*, *Volvox globator*, *Cyclops quadricornis*, *Daphnia pulex*, *Vorticella nebulifera*, and *Conochilus volvox* are described and figured. It is far better to interest the youth in the beginnings of scientific knowledge than to fill their heads with useless or silly stories as was once the practice.

MICROSCOPICAL SOCIETIES.

SAN FRANCISCO, CAL.—W. E. LOY, *Sec'y*.

June 25, 1890.—In the absence of the President and Vice-President, J. G. Clark was called to the chair. The Corresponding Secretary reported the receipt of papers from Carl H. Eigenmann, Ph. D., “On the Egg Membranes and Micropyle of some Osseous Fishes,” “On the Genus *Clevelandia*,” and “Embryology,” “Memoirs of the National Academy of Science,” vol. iv, part 2; “Annual Report of the

Bureau of Ethnology," for 1884-'85, and "The Seventh Annual Report of the Geological Survey," 1885-'86.

A donation of fossil diatomaceous deposits was received from P. Klavsen, Odense, Denmark, and with them a small quantity of recent diatoms from Odense Fjord.

William Payzant exhibited fresh-water polyzoa from Lake Temescal, Berkley, of the genus *Plumatella*, specific name undetermined. In this is the first find of *Plumatella* in this vicinity. Nothing could have been more beautiful than the expanded tentacles, gently waving in the drop of water.

July 9.—Among the visitors present were Dr. Gustav Eisen, of Fresno; M. H. Burnham, Prescott, Ariz., and W. M. Cubery, of this city.

President Wickson exhibited leaves of the cultivated blackberry afflicted with a red rust, a fungus growth—*Uredo cæoma nitens*. These leaves were sent by C. S. Upham, Moore's Station. This fungus is common on the wild blackberry leaf and on some other plants. This plant in its general characteristics and mode of growth is quite like the rust of wheat, or the rust on the rose leaf. Hybrid perpetual roses are especially susceptible to its attacks. The Government experts in mycology have recommended spraying roses or other bushes thus infected with a very weak solution of ammoniated sulphate of copper—a solution of common blue-stone with a little washing ammonia added. Six cents' worth of ammonia and sulphate of copper makes twenty-two gallons of solution of sufficient strength to destroy the fungus, and it has been noted that the sulphate of copper is of no avail unless the ammonia is also added.

Dr. Eisen mentioned, during the discussion, the vine disease of Southern California, and the destruction it had wrought. This disease has been studied by N. B. Pierce, who says it is caused by the presence of bacteria. Some of the sap of diseased vines was used to inoculate healthy vines. Soon all the symptoms and conditions of the disease were noted in these vines, and the bacteria were found in large numbers in the cells. Dr. Eisen and Dr. Mouser were of opinion that further investigation would demonstrate that other causes than bacteria were responsible for the ravages of the disease. The juice of grapes grown on vines thus infected is very bitter and unpleasant to the taste, so there is little likelihood of the same entering into human food. A further peculiarity of this vine disease is that apricot and fig trees grown near an infected vineyard also show symptoms of the disorder.

Mr. Riedy exhibited a diatom slide prepared by Thum, of Leipzig, containing 300 different species of diatoms, arranged in lines and squares and accompanied by a manuscript catalogue giving the specific and generic name of each. The diatoms were arranged after the system in Dr. H. Van Heurck's *Synopsis des Diatomées de Belgique*; and when it is considered that the 300 forms on the slide occupied a space only four millimeters square, and each individual frustule was correctly placed as to its position in the lines and squares, the manipulation necessary to this arrangement is simply a marvel.

R. H. Freund exhibited a slide of micrococci which revealed a large number of forms.

NOTICES OF BOOKS.

Structural and Systematic Botany. By D. H. Campbell, Ph. D.
12°, 253 pp. Ginn & Co., Boston.

In the present volume Dr. Campbell has abandoned the too prevalent feature of existing text-books that the chief aim of botany is to teach the ability to trace a plant by means of an analytical key, the subject being exhausted as soon as the name is discovered, and, as a substitute, advances the theory that the knowledge of the plant itself is the object to be desired. In selecting the plants employed as examples of the different groups, such were chosen, as far as possible, as were everywhere common.

The author thoroughly appreciates the value of the microscope in botanical work, as he says, "though much can be done in the study of plants without microscopic aid, other than a hand lens, for the thorough understanding of the structure of any plant a good compound microscope is indispensable." The volume, compiled as it is, cannot fail to give the student a clear apprehension of the real aims of botanical science, and is decidedly more than an "analysis" of flowers.

Best Elizabethan Plays. Edited by William R. Thayer. 12°, 611 pp.
Ginn & Co., Boston. (Price, \$1.40.)

The object of this volume is to present specimens of the best work of five of the greatest Elizabethan dramatists who stand highest among Shakespeare's contemporaries. The selection comprises the *Jew of Malta*; *The Alchemist*, by Ben Jonson; *Philaster*, by Beaumont and Fletcher; *The Two Noble Kinsmen*, by Fletcher and Shakespeare; and *the Duchess of Malfy*, by Webster. The binding together of these masterpieces enables the general reader as well as the college student to taste of the quality of Shakespeare's rivals and thereby to esteem more adequately Shakespeare himself. It thus furnishes not only the best specimen of the dramatic works of each of the five Elizabethan poets who rank next to Shakespeare, but also a general view of the development of the English drama from its rise in Marlow to its last strong expression in Webster. The author has adopted the explanations of the best editors, supplementing them from his own researches where it seemed necessary. The presence of the notes at the bottom of each page, rather than at the end of the book, is a desirable feature. Altogether it is a work equally well adapted to the library and to the class-room, and indispensable to the student of English literature.

Directional Calculus. By E. W. Hyde. 12°, 247 pp. Ginn & Co., Boston. (Price, \$2.15.)

Professor Hyde believes that the field is at last ripe for the introduction of the comprehensive system of Multiple Algebra invented by Herman Grassman and called by him *Ausdehnungslehre* or *Theory of Extension*, though it was long neglected by the mathematicians even of Germany; and the present text-book, through which students may become acquainted with the principles of the subject and its application, was designed to introduce the system to the knowledge of the coming generation of English-speaking mathematicians.

To obviate the difficulty which had been the main hindrance to the general cultivation of Grassman's process, its too great generality, the author has thought best to restrict the discussion to space of two and

three dimensions, and to make use of certain terms and symbols introduced by Hamilton, such as *scalar*, *tensor*, with its symbol *T*, etc.

Though based upon the principles and methods of Grassman, the work contains much matter that is believed to be original with the author, while a large number of exercises have been inserted in the belief that the repeated application of principles to the solution of actual problems is the true basis for acquiring a command of any branch of mathematics. The book richly deserves the attention of all interested in the science.

Handbook of English History. By E. H. Gurney. 16°, 144 pp. Ginn & Co., Boston. (Price, 85 cents.)

This little work designed as a reference handbook for readers, students, and teachers of English history, can hardly fail to gain recognition. Mr. Gurney exercised great care in compiling his materials and succeeded in producing in a compact form a work that identifies every prominent man of English history from the time of the Confessor to Victoria, giving the date of his death, to whom married, and the number and names of his children. Thus by enabling the student to trace the connection of the characters about whom he is reading saves hours of study and makes his work a pleasure.

The materials for this work have been drawn from Dugdale, Freeman, Palgrave, Longmann, Sandford, and Townsend, and many other valuable works, and the whole passed through a critical examination and comparison.

SUBSCRIBERS' NOTICES.

[These notices will be given six insertions in this column at 25 cents per line or fraction thereof.
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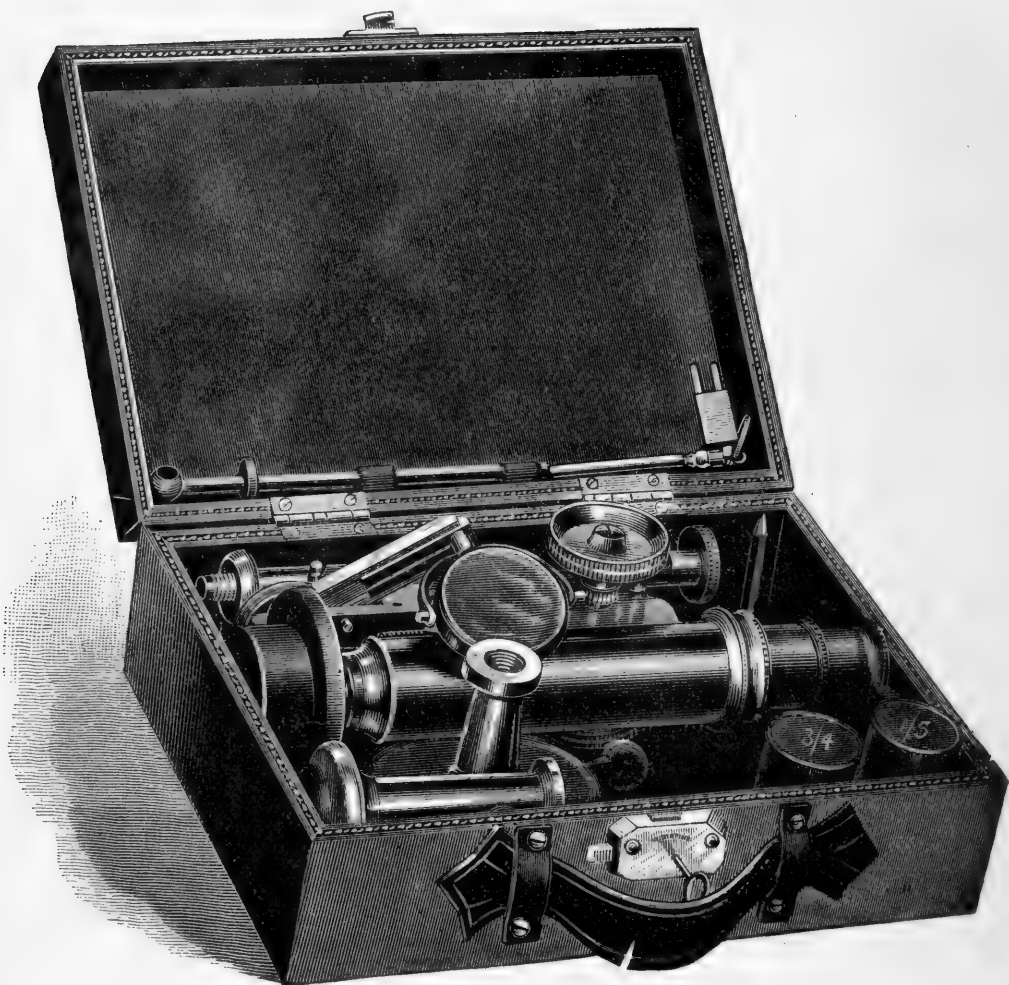
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European subscriptions may be sent directly to the above address accompanied by International Postal Order for \$1.15 per annum, or they may be sent to Messrs. Trübner & Co., 57 Ludgate Hill, London, or to Mr. W. P. Collins, 157 Great Portland street, London, accompanied by the yearly price of five shillings.

Microscopy for Amateurs.

By T. CHARTERS WHITE,

QUEKETT CLUB.

The Microscope Described.—Microscopes may be divided into two classes—simple and compound. The simple microscope may be exemplified by the ordinary hand magnifier, generally consisting of one lens, or a set of three, which may be used singly or in conjunction. A simple microscope of this class is useful, and should be the pocket companion of every microscopist; not only will it be found of value in the examination of any object which may casually offer its attractions in his walks in the country, but it will also aid in his recognition of infusorial forms in his pond explorations; it will furnish a most valuable adjunct in mounting objects as well as in insect dissection. But for more extended observation, recourse must be had to the second class—the compound microscope. The essential parts of this may require a word of explanation. Firstly, the objective, or as it is sometimes called, the object glass, is the lens or series of lenses placed at the end of the microscope tube next to the object to be examined. It is generally compounded of several lenses of varying curvature, and different refractive powers, cemented together and securely adjusted in a brass mount. When successfully mounted, they should give clear definition, a flat field, and entire freedom from color; all of which characters may be found in the achromatic objectives sold by good makers. Objectives are of different focal lengths, ranging from four inches from the object examined to one-fiftieth of an inch. The lenses sold with the student's microscope are usually one inch focus, magnifying fifty diameters, and a quarter of an inch giving 250 diameters. These have been most judiciously selected for the beginner as giving amplifications which will be found sufficient for all ordinary work he may be likely to attempt at

first. The object having been magnified by this lens, its image is received by the eye-piece, so named from being placed at the upper end of the microscope tube next the eye of the observer, and where it undergoes a further amplification. The microscope tube is mounted on a stand, and the focal adjustments are made either by moving the tube up and down through a cloth-lined tube, through which the microscope is made to slide, or by a rack-and-pinion movement, which is the more convenient method.

Below the stage on which objects are placed for examination, is suspended a mirror, having plane and concave silvered surfaces, by which daylight, or that from a lamp, is transmitted through the object. Between this and the stage, a revolving disc of metal, termed the diaphragm, and having apertures of different sizes, is fixed. This enables the observer to regulate the amount of light received by the transparent object in such a degree as to reveal details in it, which otherwise might be lost in a flood of unnecessary light. The student having a microscope of this plain and simple description, needs but a condensing lens, either attached to the stage or separately mounted on a foot for proper lighting of opaque objects, to have enough to enable him to begin his attack on the world of wonders lying at his feet. Before he does so, however, a few directions as to his method of working may be in place.

Lighting the Object.—The light employed for microscopical examination may be either the light from a good lamp or daylight. Of these, the latter is preferred, as less fatiguing to the eyes, besides giving a more correct view of the object examined. The light from a white cloud in the northern sky is especially recommended, but where this condition is unattainable, a piece of white paper placed on the mirror furnishes a very good substitute. As the student may not have the opportunity during daylight for the investigation, he must perforce use lamp light, and by placing a lump of camphor about the size of a walnut into the reservoir of the lamp, and burning some well purified paraffin, a brilliant white light can be obtained, which may, at any time, be softened by reflection from paper.

The lamp should be placed at the observer's left hand, and in advance of the microscope; it is not then in the way of his right hand and any apparatus placed there for use.

Simple Apparatus.—The student in microscopical investigation should begin his investigations by the study of the simplest subjects. Unfortunately the tendency of most newly-interested observers is to rush into an examination of the higher and more complex objects before they are thoroughly versed in the appearance presented by those elements of which the higher classes are constructed. It is well if the student can restrain his ardor till he has acquired familiarity with such simple objects as the hairs of various animals, fibres of cotton and wool, the starches of wheat, potato, and rice, and such subjects which may be found ready at hand. These may be followed by the examination of the several elementary tissues entering into the formation of the animal and vegetable structures.

When he has familiarized himself with these comparatively simple objects, he may then pass on with profit to the examination of the higher structures, when his preliminary training will be turned to advantage in the ready recognition of many of his early acquaintances

amongst the histological elements. Such a course as this tends to a gradually increasing interest, while the reverse generally ends in a settled indifference, because the evolution of a natural interest has been stifled by a premature attempt to mentally grasp what only a trained eye can comprehend.

Before the student commences the work of his microscopical observations, it is necessary that he should provide himself with a few indispensable appliances; to assist him a brief enumeration may save trouble:

Glass Slides.—Before observing any transparent object under the microscope, it must be supported on the stage of the instrument on a glass slide beneath the objective. These glass slips, procurable of any optician, are of a standard size of three inches long by one inch wide. They should be of patent plate, free from bubbles and striæ, and ground at the edges. They are not expensive, as they may be cleaned and used over again should the mounted object not be satisfactory. If they have been used for Canada balsam mounting, a short immersion in methylated spirit, to which some liquor potassæ has been added, will quickly remove the mounting medium, when the slide may be washed in warm water and wiped clean, ready for future use.

If the object under examination be opaque, such as seeds, pollen, grains of flowers, eggs of insects, and the like, the rays of light may be concentrated on them by the condensing lens, which is sufficient preparation; indeed, a juster idea of the nature of the object may be formed by this method than by any other; but if the object is intended to be examined by transmitted light reflected from the mirror beneath the stage, then it is desirable to place the object under a covering glass to keep it flat.

Cover-Glasses.—These also, obtainable at the optician's, are of different degrees of thickness, varying from one-fiftieth to one three-hundredth of an inch in thickness. Unless the magnifying power employed be greater than one-sixth of an inch focal length, it is advisable for the novice to use the thickest kinds, as the thinner glass for use with the higher powers of the microscope breaks so readily in cleaning, and it is very necessary that cover-glasses should be absolutely clean. Cover-glasses are square or circular, as the exigencies of the object may demand, or the fancy of the student may desire. Some use square covers for everything, but the circular covers have so many advantages that they are to be preferred. These will be referred to at a later period, when treating of mounting in cells and in fluid. When these cover-glasses come from the optician's they are not clean, but before using they must be scrupulously cleaned, by steeping them in warm spirits and water, and with very delicate handling wiped dry with an old, soft silk handkerchief, and stored away in a clean box till they are required for use. A simple, but very safe, apparatus for cleaning the very thin glass without breakage is formed by having two blocks of boxwood, having their ends turned perfectly flat, and covered with buff leather, upon which has been rubbed a little putty powder. These surfaces being smooth and perfectly flat, the thin glass may be rubbed between without the chance of being fractured, when a slight dusting with the old handkerchief suffices to remove any stray particles of dust.

[To be continued.]

Synopsis of a Course in Microscopy for Pharmacists.

BY DR. H. M. WHELPLEY,

ST. LOUIS, MO.

[Read before the American Pharmaceutical Association, Old Point Comfort, Va., 1890.]

The following synopsis is intended as a guide for a course of home study, and not for such work as can be followed in a College of Pharmacy, where students receive individual instruction, and have the benefit of object lessons.

Unfortunately we have no works upon Microscopy which can be taken as text-books for home instruction. There is a rich supply of works on Microscopy as applied to medicine; several volumes have been written for the microscopist who works in Chemistry, and the number upon the use of the microscope in the study of Botany is not small; we even find works devoted to the application of microscopy in petrology. At no far distant day we shall have works upon microscopy for druggists.

In order to apply the Microscope to pharmacy, the druggist should be proficient in botany and pharmacognosy; in other words, he must have the advantage of home reading or a pharmacy college training. Colleges of pharmacy in this country now have departments devoted to microscopical work, but those who graduated a few years ago did not have such training. Many at present overlook the value of microscopy while they are students, and defer the study until they have engaged in business.

Although the educated pharmacist has quite an advantage when he takes up the study of microscopy, the same as he has in daily pursuits, still he whose opportunities for study have been very limited; can advantageously follow out a course of home study. The microscope can be taken up in connection with pharmacognosy, chemistry, and other studies which must be pursued.

One of the branches which is usually overlooked in colleges of pharmacy is physics. The average student receives but a very meagre training in this branch during his school days. In order to comprehend the principles upon which the microscope is constructed, a person must be familiar with that branch of physics. Therefore every person taking up a course of study in microscopy should first familiarize himself with optics. The chapter upon this subject given in the works on microscopy is scarcely sufficient; it is better to study some work devoted to physics. Chapter VII in Norton's Natural Philosophy is very good. The chapter upon optics in Steele's Fourteen Weeks in Physics is also of value.

After mastering optics study the microscope as an optical instrument. Microscopes are divided into simple and compound.

It is best for the home student to confine his first work to the simple instrument. Purchase Manipulations of the Microscope by Bausch (a fifty cent book); also, How to Work with the Microscope, by Phin (\$1.25); a new edition has just been issued. Simple microscopes are not expensive; you can purchase a good one with three separate lenses for from twenty-five cents to two dollars and fifty cents.

Do not begin by studying drugs and objects the structure of which is unfamiliar, but examine such things as the integument on the palm

and back of the hand, the print of the newspaper; the web of cloth, etc. After becoming familiar with the changed appearance of such objects when seen under the simple microscope, take up less familiar substances, such as seeds, leaves, roots, powders, crystals, etc. The hairs found upon many of the vegetable drugs are very interesting and instructive—they serve as one means of identification of the substances. After considerable practice the student is ready to take up the alphabetical list of substances in the U. S. Pharmacopœia. A simple microscope will enable him to observe the microscopical character of a large number of this list. The hairs on nearly all of the leaves are characteristic. The warts, wrinkles, ridges, hairs, scales, scars, etc., on branches, barks, rhizomes, roots, and other parts of plants, often serve as a means of identification. Those drugs which consist of whole or parts of flowers are also suitable for examinations. For some of the pharmaceutical preparations, such as mercurial ointment, mercury with chalk, etc., the Pharmacopœia directs the use of a microscope in testing their value.

The student should not be anxious to handle the compound microscope before he is perfectly familiar with the use of the simple instrument.

There are other uses in a drug store for the simple microscope than the examination of drugs, such as the making out of the number of a prescription upon a soiled label.

When ready to buy a compound microscope, purchase a good stand. This will enable one to add accessories in the future as time, inclination, and financial condition may permit. The cheapest compound microscope, suitable for a drug store, costs about twenty-five dollars. The Library Microscope is supplied with one-fourth inch and one-inch objectives, which give a magnifying power ranging from eighty to three hundred and seventy-five diameters. Fifty dollars will secure a very fair outfit, giving one-fifth and three-fourth inch objectives, which are the ones most generally used. It is better to invest about seventy dollars, and secure a good stand with one-fifth and three-fourth inch objectives. Such an instrument will admit of the use of almost any accessories which a pharmacist will ever have occasion to use. As an example of a microscope for this price I will mention the Griffith Club Microscope. Unless a pharmacist feels inclined to be lavish in the investment, it is not necessary to purchase a microscope costing more than from seventy-five to one hundred dollars.

When commencing it is better to learn to manipulate the stand with eye-piece and objectives before any accessories are added. The books recommended for use in studying the simple microscope are still more serviceable and essential when it comes to the compound. In addition it is advisable to read one or both of the microscopical journals published in this country: *The Microscope* of Trenton, N. J., and the *American Microscopical Journal* of Washington, D. C. The subscription price is one dollar per year, the same for each publication, or \$1.80 for the two if ordered from the latter journal. The student will also be interested in the notes on microscopy in the various pharmaceutical journals.

In commencing work with the compound microscope, it is best to follow the same plan as suggested for the simple—to first study familiar

objects. Among these we have the various fibres, such as wool, silk, cotton, and linen; every microscopist should be able to identify each one of these fibres. Small seeds, hairs, and even the dust which collects in a room, are suitable for study. When it comes to less familiar objects, we have various kinds of starch grains, powdered drugs, and other substances which require no section cutting in order to be examined.

It is not advisable to attempt the preparation of permanent mounts for the microscope until the student becomes quite familiar with the examination of objects. By this time another work will prove of service to the pharmacist, and that is *The Practical Microscopist*, by Davis (\$2.50). As a guide in the study of powders, I call attention to articles by Hans Wilder, entitled "Microscopical Examination of Powders" (*American Journal of Pharmacy*), June, '90, page 278; July, '90, page 332. Another source of valuable information on the subject is Bulletin No. 13, issued by the Division of Chemistry of the Department of Agriculture; parts I to V, are of interest to pharmacists, but it is part II that treats of the examination of powders. The bulletin is entitled "Food and Food Adulteration," and can be obtained by addressing the Secretary.

If the student can afford the expense of a polariscope (which costs from twelve to twenty dollars, and which can be used with the seventy-five-dollar outfit), it is advisable to purchase one at this stage in his study. The polariscope is especially serviceable in the examination of starch grains, crystals, and many other substances.

The student is now ready to mount specimens for examination and preservation. It is best to commence with the preparation of dry mounts, such as are made with the use of paper covers. Then come dry mounts with the use of cements. A turn-table is essential to the outfit of any one who prepares permanent mounts; it not only enables him to make more elegant preparations, but saves time and trouble. After learning to prepare dry mounts, the use of balsam, both hard and soft, is in order. Those who have access to the *Companion to the U. S. Pharmacopœia* will find the chapter on the subject of Microscopy very instructive when they come to the use of balsam, glycerine jelly, or glycerogum, and other mounting media which require similar technique. The use of balsam should be studied before passing on to mounts made in liquids. The latter is more difficult than the foregoing media. Glycerine, carbolic acid, and creosote water, castor oil and other liquids used in mounting, all require about the same work, and can be studied together.

After gaining proficiency in mounting specimens, the student should take up section-cutting. It is best to commence with free-hand work, such as cutting soft vegetable tissues imbedded in elder-pith. It is very convenient to be able to make such sections, and sometimes circumstances are such that it is necessary to make them free-hand with a razor, or not at all. If the student does not practise this before he commences the use of the Microtome, he will never learn the art. An ordinary potato is a very good substance to practise upon for free-hand section-cutting. The first work of the Microtome should be on such substances as rhizomes of ginger, calamus, podophyllum, etc., which can be imbedded in paraffin or similar imbedding substances.

We next come to the section-cutting of hard vegetable tissues like Pareira Brava, which requires special soaking, but no imbedding. Cutting sections of fruit stones, coral, minerals, etc., are not in order. They require the use of a saw and grindstone.

The student is next ready for the more difficult task of sectioning animal tissues and spongy vegetable substances, which are best imbedded in celloidin. I find that it is better for the student to learn to make sections and carefully handle them, before he attempts to mount specimens which require sectioning.

An artistic talent is not the good fortune of every one who studies microscopy, but any one can learn to draw more or less correctly what he sees under the microscope. The practice teaches the student to closely observe what he sees. Commence drawing at the first lesson.

Urinary analysis is work suitable for the pharmacist, but requires special instructions from teachers or books.

Every one who works with the microscope should start a cabinet of permanent mounts. Whenever mounting a substance, one should make several preparations, so that he can select one for his cabinet and exchange the others with his brother microscopists. For use in examining drugs, it is well to have mounts of the true drugs and also of known adulterants.

Study the illustrations of the microscopic appearance of drugs as given in Maisch's *Organic Materia Medica* and the *Dispensatories*, as well as other works on Pharmacognosy. He who has time and inclination will profit by work in photo-micrography.

There is a large field for individual and original work for the microscope in Pharmacy. The pharmacist who accomplishes most will be the one who sets apart a certain amount of time each day or week for the use of the instrument. There is an infatuation about the use of the microscope which sometimes leads the microscopist to devote more time to the subject at one sitting than can be afforded, so that the instrument must be set aside and neglected. Therefore I advise every pharmacist who takes up the study of microscopy to lay out a schedule of work, and follow it closely.

System and order are of as much value to the microscopist as to any workman. It is best to have a table, closet, or box for the accessories and reagents, so that they may be kept together. The microscope is very conveniently kept under a bell-glass, so that it is always ready for use at a moment's notice.

CORRESPONDENCE.

I am pleased to see the notice of my esteemed friend W. H. Bullock, in the July number. I am sorry to have him leave Chicago, but I hope it will be for the best. You will find him a gentleman in every sense of the term. I have been acquainted with him for 16 years, and have seen his best work. I can state without any reserve that his stands are the best ever made by the hands of man. I have examined the stands of other makers and there is no comparison.—*Pierce Tyrell, M. D., Elgin, Ill.*

Imbedding Seeds by the Paraffin Method.*

BY W. W. ROWLEE,

ITHACA, N. Y.

The modifications that may be made of the paraffin method of imbedding objects for sectioning, are very many. There is always, however, some danger of shrinking delicate and very soft plant tissue. This is due to the use of heat in the process of infiltration; and probably some of the non-heat-employing methods will be found preferable where such delicate tissue is to be imbedded. But, for objects that will withstand this process of infiltration, the paraffin method has many advantages over others. Imbedded in paraffin, objects are held firmly and may be preserved as long as desired without further attention.

For imbedding mature seeds I have found nothing equal to paraffin. The texture of the seed is often very dense, and offers much resistance to the knife. For this reason I found it better to use the harder grade of paraffin. A second serious difficulty that was met with in imbedding seeds, was the fact that there was little, if any, tissue connecting the embryo† with the seed-coats. Thus it would happen too often that just as the sections were being taken through the middle of the seed, and the most valuable ones are those near the centre, the embryo would leave the coats and the whole series would be spoiled. The inner surface of the inner coat in many seeds is highly polished, and as soon as there is nothing to retain the embryo but its adhesion to the coat, it will loosen. The paraffin does not hold the two together as would be expected. It was suggested that, in order to soften the tissue and thereby make it more susceptible of infiltration, it would be well to thoroughly soak the seeds in water before hardening in alcohol. This was tried, and there was a great improvement in the results. Fewer of the sections went to pieces after they were transferred to the slide, and the parts of the seed kept their respective positions much better.

In order to study the microscopic structure of seeds, much more satisfactory results can be obtained if the sections are kept in series. It is often necessary to have two or more successive sections before a correct idea of the seed can be obtained.

The method is a modification of the one used and taught in the histological laboratories of Cornell University. In its practical application it is as follows: In choosing seeds to section great care is taken to get those which are well filled. This precaution is especially important, as many seeds, for various reasons, never develop more than the coats or the enveloping ovary coats. If a seed has a straight embryo or even a bent or curved one it is better to determine by dissection just how the parts of the embryo are arranged with reference to the external parts of the seed. Thus the seeds of *Helianthus tuberosus* are flattened and slightly wedge-shaped. The embryo within is straight and the upper or inner surface of the cotyledons lie in a plane parallel to the plane in which the seed is flattened. Moreover the cotyledons are in the upper broader end of the seed. Where the seed has no external character, as in a eupatorium, by which the position of its internal

* Read before the American Microscopical Society at Detroit, August, 1890.

† The term "embryo" is used here where on some accounts it would be better to use the word "nucleus." The embryo is often but a very small part of the substance contained within the seed-coats.

parts may be located, one has either to take the chances on getting the sections in the right plane, or open the coats enough to see how the parts are arranged and then mark the seed in some way. Having selected a well-filled seed, I next put them in water at the ordinary temperature of the laboratory from 24 to 36 hours. From the water they are transferred to weak alcohol (40 per cent.) and gradually hardened by transferring to stronger until they are in 95 per cent. alcohol. Schultze's apparatus may be used to advantage in hardening. Next transfer to equal parts of alcohol and chloroform for from 4 to 8 hours, the time depending on the size of the seeds. Then in pure chloroform for the same length of time. Then for 24 hours into chloroform with as much paraffin in it as it will dissolve at the ordinary temperature. From this into paraffin softened with chloroform, the melting point of which is about 36°C . The specimens are kept in this melted paraffin 24 hours. I have always been careful not to let the temperature go above 47°C ., although I think it probable that a somewhat higher temperature would not injure the tissue of a seed. From this the seed may be imbedded in hard paraffin and will be found to be thoroughly infiltrated.

The seeds may be sectioned in the paraffin blocks either free-hand or with a microtome. It is highly essential that the sections be kept in series and that none be missing. The texture of a seed is so fragile that when cut in thin sections the least carelessness may spoil a section. A very effectual way to keep sections intact when they are cut in paraffin is that proposed by Dr. Mark (*American Nat.*, 1885, p. 628). It consists in collodionizing the object as the sections are taken. Very thin collodion should be used and applied to the cut surface after the section is taken. Lee (*"Vade Mecum,"* 2d edit., p. 150) recommends that "the collodion be of such a consistency that when applied to a surface of paraffin it dries in two or three seconds. This has no tendency to cause the sections to roll. * * * As soon as the collodion is dry, which ought to be in two or three seconds, cut the section, withdraw the knife, and pass the collodionized brush over the newly exposed surface of paraffin." The section is placed collodion side down on the slide. They may be fastened by first painting the slide with a few drops of clove-oil collodion, placing them in it, and then evaporating off the clove oil.

The sections are then placed in xylol for 15 minutes. This removes the paraffin. They are then washed in alcohol, afterwards with water, and stained. I have found no stain that was as effective in staining seeds as hæmatoxylin. They should be stained from 3 to 5 minutes. After washing the staining agent away with water, dehydrate with alcohol, and clear. Three parts of turpentine and two parts of carbolic acid make a very good clearing mixture. Canada balsam dissolved in xylol is used for mounting. In sections thus prepared one can distinguish without difficulty in Shepherd's Purse, Goldenrod, or any endospermous seed, the coats, the plumule composed, as is the lower tip of the radicle, of small thin-walled nucleus-bearing cells. These two regions of growth are connected by slightly elongated cells which are also thin-walled. The larger cells making up the tissue of the cotyledons are stored with food. In many seeds a trace of a fibro-vascular system may be seen; also the peculiar arrangement and markings of the cells composing the coats.

Seeds differ so much that one would need to make many variations in method to suit different cases; but as a general method I have found this to be a success, and I believe the histology of any seed may be demonstrated by applying it.

New Stage Micrometers.

By E. M. NELSON.

[Read at the Royal Microscopical Society, May, 1890.]

Messrs. Powell and Lealand have a new micrometer so excellently ruled as to be worthy of remark. It comprises 100ths and 1,000ths of an inch, and 10ths and 100ths of a mm., there being 10 divisions of each set; the finer divisions of .001 in. and .01 mm. being placed in the centre, the .01 in. being on the one side and the .1 mm. on the other, respectively, a guiding line being ruled at right angles to them. The lines are fine, $\frac{1}{30000}$ in., and are blackened in and mounted in balsam. The lines are straight and evenly ruled. With regard to the spacing, I have made exhaustive comparisons with fine micrometers by Rogers and Zeiss, and some others not quite so perfect. Upwards of 240 screw micrometer measurements were made, and the work carried on under hypercritical conditions. An account of these may be of interest. First, a magnification of 1,200 diameters by means of a suitable immersion lens was employed for the finer ruling, and for the coarse a dry $\frac{1}{6} \times 600$ diameters; the screw micrometer was on an independent mounting. Care being taken with regard to the illumination, etc., a critical image of the lines was obtained. The order in which the lines were taken was from left to right, as seen in the instrument; each interval was then designated by consecutive letters of the alphabet. The intervals were then most carefully wired, and each value set down under its corresponding letter; when the ten spaces were finished they were meaned.

It was then easy to see which interval differed from the mean, and to calculate how much. In the same way comparison can be made with any other scale, it matters not whether it is ruled in inches or mm. It is most important that both the instrument and the observer be tested. To this end I proceed as follows: The screw value of 20 intervals on a badly ruled scale was written down as above, the paper was then put away, and the operation performed again.

On comparing the two papers, the screw values of seven intervals were identical, 12 different by one division, and 1 by two divisions. This error of two divisions occurred in the interval H, the first reading being 1033, and the second 1031. On careful re-examination of this interval, I came to the conclusion that the first reading was the bad one, and that the true value was 1031 or 1032. On substituting this last value in both sets of readings, the 20 intervals meaned precisely alike, viz., 1038. This forms a suitable illustration of the work. With the exception, therefore, of the interval H, the screw readings may be taken as true to ± 1 . The mean 1038 being the value in divisions of the screw-head, for 50μ , the value of one division consequently = .000001897 in., or less than 1-500,000 in.

This might be called "the constant of the instrument and observer."

We next have to find the greatest errors of the intervals from the mean; G is the greatest, and S the least. Calculation shows that G is 1-20,000 in. too large, and S 1-40,000 in. too small. But, on returning to Powell's scale, we find a much closer agreement than this. Taking the .001 in. first, we find the mean to be 628.0. Three out of the ten intervals agree to that mean to ± 1 , this being "the constant of the instrument and observer," they are without sensible error. Four intervals agree to ± 2 , which is less than 1-300,000 in.; two lines B and H agree to ± 3 , which is less than 1-200,000, and one interval G is ± 4 , viz., 1-157,000 in., too large. Now, as we found that ± 1 was the limit of observation, we may say that the scale, with the exception of B, G, and H, has no sensible error. Practically speaking, G is the only interval that is out, and its error is small in comparison with the other scales.

The next scale is the 1-100 mm. The .01 mm. is too small a quantity to treat in the above way; it must be left until we have objectives as perfect as those we have at present, but of double their power. All that can be done is to take several of the divisions. Eight sets of three each were measured on Powell's new scale; the variation from the mean was less than 1-200,000 in. Rogers' is a very well ruled scale; it is, however, difficult to observe, the lines being without pigment, and it is mounted dry. The lines under these circumstances present the usual black and white diffraction images. It is, on that account, very difficult to maintain an equable focus during measurement.

In Rogers' scale the greatest error is in interval G, where it amounts to four divisions, or somewhat less than 1-100,000 in. Thirteen out of twenty intervals have practically an insensible error. One cannot speak with the same certainty with regard to this plate as to the others, because of the focal difficulty. Different readings give discordant results; therefore, in this case, more must be allowed for the "constant of the observer and instrument." With regard to the 1-10ths of a mm. on Powell's scale, they were examined by a power of 600 diameters with a dry lens. The mean was 987; six intervals had no sensible error, but C and G had an error of three divisions, which is equivalent to 1-100,000 in. Rogers' gave a very similar result.

The error of the internal D, in the Zeiss scale, was 1-30,000 in.

I next compared the length of the mm. on the three scales, that is, Powell's, Rogers', and Zeiss' with each other. I detected a slight but insensible difference of ± 1 . All that now remains to be done is to compare the inch and the mm. scale on Powell's plate. By measurement we found that 30 μ gave a screw value of 741.25; therefore, the value for .1 mm. would be 2470.8, and the value for 1-1,000 in. $.001 \times 2470.8 \div .003937 = 627.59$.

The value actually measured was, as we saw above, 628.0. Here again there is no sensible discrepancy. In conclusion, I feel sure that such an accurately ruled micrometer, and one so clear to read, will prove extremely useful to microscopists at large.

Before closing, I would like to bring to your notice a screw micrometer made for me by Mr. Powell, which contains some slight modifications from the usual forms and suggested to me by practical experience.

First, with regard to the lens portion, I have substituted a compensating positive for the old form of Huyghenian or Ramsden. This yields far better images when making measurements with apochromatic

and ordinary objectives. I have so arranged it that the compensating eye-lenses of different foci are interchangeable. In fact, no special lens is required; you use your ordinary working eye-piece, whatever that one may be. This is, of course, a great advantage; bacteria, for instance, require a high power eye-piece micrometer, while such a power would be useless on an ordinary object. Therefore, the ability to regulate your eye-piece power to the object to be measured, will meet a long felt want.

Next let me say that I entirely disapprove of having two movable threads; at the outset "the constant of the instrument" would be doubled; moreover, I am confident that a movable zero is a mistake. I have, therefore, considerably altered this portion of the instrument by making the screw portion, together with the fixed zero thread, movable in the other part, which might be aptly termed "an eye-piece adapter." By this we secure the advantage of the double movable thread, without the additional error of the double movable thread, and this, moreover, without losing the convenience of a fixed zero. This enables you to span your object at equal distances on either side of the optic axis without disturbing the centricity of the eye-piece. A guiding line has been added, because an error might creep in unless measurements are made with precisely the same portion of the wires.

The divisions of the screw-head have been made white on a black ground, on account of their being easier to read in a darkened room. A cap to protect the thread from dust and injury, etc., is provided as the threads are no longer inclosed between the lenses as in the Huyghenian form. An iris diaphragm is placed below the threads and as close to them as possible.

In spanning the stage micrometer it will be found better to take the readings from centre to centre of the lines, by doing which you avoid the diffraction which is always present at the edges.

The measurement of all objects should be performed under a wide-angled cone of illumination so that the diffraction at the edges may be minimized as much as possible.

NOTES.

Materials of the Microbe-Raiser.—Some of the means and methods of the micrologist, in his researches, must be mentioned. His outfit is extensive and novel. It includes the best known microscopes and a well-constructed incubator with heater and thermometer, numerous test-glasses, beakers, filters, acids, alkalies, deep-colored dyes, and a good supply of prepared cotton.

In studying the life-history of his microbes he will require a well-supplied commissariat. He must be a professional caterer and a bountiful feeder. He must have fluids, semi-fluids, and solids, broths of various meats, peptonized food, the serum of blood, *a la Koch*, and Pasteur's favorite recipe with the French refinement: Recipe, 100 parts distilled water, 10 parts pure cane sugar, 1 part tartrate of ammonium, and the *ash* of 1 part of yeast. Among the substantials must be found boiled white of egg, starch, gelatin, Japan isinglass, and potato—the last, from South as well as North America.—*From Invisible Assailants of Health, by Samuel Hart, M. D., in The Popular Science Monthly for October.*

A Rare Specimen of Crystallized Gold.

By HENRY G. HANKS.

SAN FRANCISCO, CAL.

[Read before the Microscopical Society, August 27, 1890.]

This specimen was found in Summit county, Col., in 1887. The "Gold Crystal Mine," from which it was taken, is what is known to miners as a "pocket mine," and the variety, "seam diggings." The seam lies in black slate, and is associated with red oxide of iron, probably changed from pyrites. The auriferous portion varies from the thickness of a knifeblade to six inches. The specimen occurred at the junction of two seams of the same character. Coarse gold had been panned out near by, which encouraged the miners to drive a tunnel leading to the discovery of the seam.

The weight of this specimen is 92 7 Troy ounces; extreme length, 7 inches; width, 5 1-16 inches; thickness, 3 inches; specific gravity, 7.51368 +; fineness of the gold, 814; fineness of the silver, 150; value of the gold per ounce, \$16 82.

In excess of its intrinsic worth it has high scientific value, and it is to be hoped it will find an honorable position in some national museum, for it would be an insult to nature and a serious loss to science to send it to the melting pot. The beauty of the crystals, of which it is almost wholly composed, could not be fully appreciated without the aid of our favorite instrument. While to the eye it is a beautiful and interesting object, it is simply wonderful when its crystallographic details can be studied under an amplification of from twenty diameters upward. Many of the faces, when so magnified, assumed the form of depressed panels, a rare peculiarity of gold, although before noticed by mineralogists. The crystals were generally small, and not all perfect; but their details, both as individuals and in groups, are worthy of careful study.

The condition of the crystals would indicate deposition in the vein by slow accretion, from a fluid holding gold in solution. It was not possible that such a specimen could result from fusion and subsequent crystallization while the mass slowly cooled, an opinion held by some geologists.

Recently J. O. Whitney brought a fine lot of nugget gold from the Scott river hydraulic mine, in Siskiyou county. While the specimens did not equal the above in beauty, they were not deficient in avoirdupois, and the object lesson they teach is no less interesting. On examining the golden pebbles they were found to be simply rounded masses of bright, yellow gold, without the least trace of crystal, wire, or leafy form peculiar to the same metal in quartz.

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The Relation of Bacteria to Practical Surgery.—The *Times and Register* of July 19, 1890, contains a paper by John B. Roberts, M. D., with the above title, which is well worth any physician's reading.

It is a plain statement, without needless technicality, of the points in bacteriology which are of value to the practical surgeon—the best résumé of the kind that we have yet seen. The only exception we take to the paper is the acceptance of phagocytosis as a proven fact.

Photo-Micrography.*

BY M. E. SWAN.

The essential apparatus for this study are, a microscope, having a short and wide body, a camera of the simplest construction, together with a few dishes and reagents.

It is an advantage to have an adjustable base-board on which to set up the apparatus, but this is not absolutely essential.

The camera can be made by any amateur joiner out of any light case, such as a soap box, at a cost of next to nothing, the only part necessary to purchase being a back, as it is called, and the cheapest form I know is Lancaster's metal double back, which will carry two plates $3\frac{1}{4} \times 4\frac{1}{4}$ back to back, and costing 2s. 6d.

A dark room is necessary to work in, but at night time there are generally but few difficulties in the way of the photographer, and a little ingenuity will generally succeed in darkening any ordinarily lighted room even in daytime. My own work-room is rendered suitable for photography in less than ten seconds by lifting a canvas and paper screen into the window space and securing it there by two turn buttons. This screen has a square hole containing a sliding piece of ruby glass, which was the most expensive part of the whole thing, which did not cost two shillings to make. A connection must be made to adapt the tube of the microscope to the lens hole of the camera, but even this may be dispensed with and a black cloth used to stop any stray light entering.

The light may be either daylight or artificial, and the latter, except under certain circumstances, is generally preferable, being more manageable, and further, as most of my work is done at night, is absolutely necessary. A paraffin lamp is all that is needed to supply the light, and if a flat flame is used the edge of the flame should be used as the source. The bull's-eye condenser is used so that a bright image of the flame is focussed on the object, and the camera being in position the object is focussed on the ground glass of the camera.

A velvet-lined tube should be inserted into the body of the microscope to prevent central flare. A good "fine adjustment" to the microscope is desirable, one that acts readily and accurately both in approaching and withdrawing from the object, and if its movement is truly in the optical axis of the instrument (which unfortunately is very rarely the case), so much the better when photographing different objects which do not lie all in one plane.

The focussing screen now demands attention; ordinary ground glass is too coarse, except for very rough focussing. An improvement is to varnish a sheet of plain glass with an ethereal solution of sandarach, which dries with a very fine, smooth surface. A still better screen is a polished glass with a few lines ruled on it. The image on such a screen is invisible to the eye alone, but may be viewed with a lens, and when the image and the lines on the glass both appear equally sharp, the best focus has been obtained.

Perhaps the best method is to have a wooden screen perforated with holes, into which a spare eye-piece is slipped to such a depth that the diaphragm coincides with the plane in which the plate lies in the

* Read at a meeting of the London Chemists' Assistants Association.

“back,” or, in other words, with the ground surface of the ordinary screen. With such an arrangement, or a modification of it, it is easy to obtain sharp definition with so high a power that the image would be absolutely invisible on the ordinary screen, owing to the loss of light and amplification.

The time of exposure will vary with the intensity of the source of light, color, and density of the object, sensitiveness of the plate, and the magnification of the object. By using plates of one degree of sensitiveness and always using the light as nearly as possible under the same conditions, two of these variables can be eliminated, and by remembering that roughly the time varies as the square of the linear amplification, an idea can be formed of the proper exposure.

It would be highly desirable that some standard should be arrived at, but the difficulty of determining a standard of light has not yet been fully overcome.

The nearest approach to any refinement of the kind is that described in a “Manual of Photo-micrography,” by Dr. Bousfield, and involves the use of Warnerke’s sensitometer screen.

This screen, which consists of a series of spaces numbered from one to twenty-four, containing smoke-colored tissues of regularly increasing density, by application to the focussing screen, affords a guide to the intensity of the light falling on it; and the method of use is to read the last number visible, and, knowing the rapidity of the plates in use, refer to a table which has been deduced from a number of experiments.

In color experience alone must guide; reds and yellows, as a rule, are favorable to photography, while blue and violet, which are transparent to the actinic rays, are difficult to obtain satisfactory negatives from.

Any of the well-known brands of plate may be used, either ordinary speed or rapid, but there is no advantage in the use of rapid plates with low powers, say, up to half an inch; after that, exposures begin to become tedious, even with rapid plates, so much so that any one doing much work requiring high powers would have to obtain an illuminating source of higher actinic power, such as the electric arc or oxyhydrogen lime-light.

Magnesium can also be used, but is rather costly, and there is much difficulty in dealing with the smoke from it and in keeping the glowing point accurately in the focus of the condenser.

Sunlight has even been used with success by Dr. Woodward and with the heliostat to obtain a constant beam, good definition has been obtained up to 5,000 diameters.

The exposure made, the plate is taken into the dark room and there developed.

The plate, which is a square of glass coated with gelatin, holding in suspension various haloid salts of silver, is, after exposure, to all appearance the same as it was before, but a subtle change has taken place, for all those parts of the plate upon which light has fallen during exposure are now highly sensitive to the action of certain reducing agents, many of which might be employed, but practically we have to choose between three processes, viz., ferrous oxalate, pyrogallol, and quinol.

The developer is poured on to the plate, and the latter is watched in

a "safe" light until the image has well appeared and shows well through the back, which if all has gone right should be in two or three minutes; the plate is then washed in two or three changes of water and fixed in thiosulphate of soda or "hypo," as it is more commonly called.

The "hypo" dissolves out of the film all the unchanged salts of silver, but leaves untouched that part that has been blackened or reduced by the developer.

The fixing bath should be allowed to act for fully ten minutes, in order to completely remove all unreduced silver from the film, and it then must be subjected to a prolonged washing in running water till all traces of the salt is removed, or the negative will inevitably deteriorate.

The negative is now allowed to dry spontaneously, and if valuable may be varnished to preserve it; but this is not absolutely necessary, as it does not improve the printing qualities, and with ordinary care the plate does not suffer any injury in printing.

Printing may be effected on ordinary sensitized albumen paper by daylight, but if opportunities for printing only occur at night, bromide paper may be used.

The surface of bromide paper resembles that of the plates used for the negatives, and good contact prints may be made by gas or lamp-light, which must be developed in exactly the same way as the plates, viz., with ferrous oxalate or quinol, pyrogallol as a rule not being so well adapted for paper development.

Lantern transparencies can be produced in exactly the same way on gelatin-coated plates, either by contact printing or the use of camera and lens.

BACTERIOLOGY.

Bacteria found in Influenza.—Secretions from the respiratory passages and juices from the various organs from cases of influenza were used by Dr. V. Babès as intravenous and subcutaneous injections in guinea-pigs and rabbits. The animals were also infected by rubbing their nasal mucosa with the tainted discharge. Many of the animals succumbed to the poison, but on the other hand many survived, an inflammatory swelling only being developed at the place of inoculation. From the organs of the animals which died cultivations were made on agar, gelatin, and potato, and several forms of bacteria developed. Among these were *Staphylococcus pyogenes aureus* and *albus*, and also a *Staphylococcus* from 0.8 to 1.0 μ broad, which did not liquefy gelatin, and was not pathogenic. Of the bacilli, two forms distinguished as B *i* and B *ii* are specially noted. The colonies of bacillus *i* are distinguished by being perfectly transparent and colorless. The individual elements which are extremely small, from 0.2 to 0.4 μ thick, form small chains or threads. They are only faintly stained by anilin pigments, and not at all by Gram's method. They are quite motionless. Bacterium *ii* was found to stain well. The primitive elements, usually in pairs, are about 0.5 μ broad, with pointed ends. Transverse striations could be detected. These bacilli did not grow on gelatin, but thrived on potato. They were found to be pathogenic to mice and guinea-pigs, their chief effect being exerted in the lungs.

Besides the foregoing colonies of oval bacteria, slender bacilli and thick bacilli were also observed.

These observations were made from cases occurring during the height of the epidemic, and another set is given from cases of pneumonia, which started as influenza. Among the micro-organisms isolated from the latter cases were *Streptococcus pyogenes*, a lancet-shaped diplo-bacterium, and a bacterium the colonies of which formed mucus-looking masses below agar layers or upon gelatin. They were pathogenic to mice and rabbits.

Dr. Bouchard, after narrating instances of the contagiousness of influenza, proceeds to say that he found three pathogenic microbes of influenza, "two of which are too many if we go for a specific virus of influenza." All these three microbes are the constant companions of the various cavities of the human body. Hence, in order to have any casual relation to influenza they must have exceeded the ordinary condition of their existence. The author's view that *Streptococcus pyogenes aureus* is the only microbe capable of producing pneumonia wants further corroboration. This microbe was isolated from the vesicles of *Herpes labialis*, and was found also in the pneumonias complicating influenza. *Streptococcus pneumoniae* was found by the author in the bronchial secretion, but not in the blood. This microbe is considered by the author to be identical with the *Streptococcus* of erysipelas, of suppuration, and of puerperal fever.

Dr. T. M. Prudden has examined seven cases of unmistakable influenza. Cultivations were made on agar and agar-glycerin plates at the temperature of the body. The pathogenic forms discovered were *Staphylococcus pyogenes aureus*, *Streptococcus pyogenes*, and *Diplococcus pneumoniae*. The author concludes that bacteriology has "brought to light no living germ which there is reason to believe has anything to do with causing the disease." When compared with Ribbert's investigation of quite a similar set of cases, *i. e.*, influenza with and without pneumonia, it is found that the author discovers *Diplococcus pneumoniae* in tolerable frequency, while Ribbert does not mention this microbe at all.

Dr. Ribbert examined seven cases dead of influenza for bacteria. Cultivations were made from lungs, trachea, spleen, and kidney, on agar. Having found in five cases *Streptococcus pyogenes* vel *erysipellatis*, the author asks if this microbe can be the excitant of influenza. If this be the case it is obvious that the *Streptococcus* must have acquired, temporarily at least, pathogenic properties differing a good deal from those usually attributed to it, but it may be acknowledged that when once the disease has been set up, this micro-organism plays at least an important though secondary part.—*Centralbl. f. Bakteriolog. u. Parasitenk.*, vii (1890), pp. 233-41; *J. R. M. S.*, June, 1890, pp. 373-5.

Bacterial Diseases of Corn.—Prof. T. J. Burrill has from 1881 to 1889 observed a disease which attacks young corn, and frequently causes great devastation. The first indication is a dwarfish, wasted appearance of the plant. The condition of the soil seems to pay no unimportant part in the spread of the disease, for the author was able to determine that in a large rye-field, of which one part had been a reclaimed marsh, the plants herein were diseased, while in the drier

portions there was scarcely any disease. The plants attacked stop growing, become yellow, dark slimy spots appear on stalk, leaf, and root, and then they soon die. Microscopical examination of the dark slimy masses, which occur within and without the plant, shows that they contain a large quantity of rod-shaped bacteria and others of a spheroidal shape, both varieties being of one and the same species.

These bacteria were found to develop easily at ordinary temperatures, but above 36° C. their growth ceased. At first independent motion was seen, but later observations failed to verify this. They do not liquefy gelatin.

In fluid media the individual elements are larger than in solid media. Their breadth is about 0.65μ , and they vary in length from 0.8 to 1.6μ . Spore-formation was never observed.—*University of Illinois Agricultural Experiment Station, Champaign, 1889, Bull. No. 6*, pp. 165-73; *Cf. Centralbl. f. Bakteriöl. u. Parasitenk.*, vii (1890), pp. 70-71; *J. R. M. S.*, April, 1890, p. 226.

Microbic Products which favor the Development of Infection.—Mr. G. H. Roger finds that bacterial secreta have partly poisonous, partly vaccinate properties. There are, therefore, among these some which favor the development of certain viruses. This latter phase has been observed by the author in the bacillus of symptomatic anthrax. This bacillus, which by itself is harmless to rabbits, speedily kills them if another microbe be injected along with it. This can be done with *Staphylococcus pyogenes aureus*, *Proteus vulgaris*, and especially with *Bacillus prodigiosus*.

A similar result can be obtained from the anthrax bacillus itself. For if the serum from an anthrax tumor be deprived of its cell-elements by means of a porcelain filter, 4 to 5 ccm. per kilo. of live weight can be injected without harm, while 1 to 1.5 ccm. coupled with the anthrax bacillus quickly kills. The morbid predisposition induced by such a procedure is, however, of short duration, lasting not more than twenty-four hours, after which the animal again becomes refractory. Hence it would seem that a vaccinate effect is preceded by a period of diminished resistance to the virus.

Another observation showed that the anthrax bacillus did secrete products favoring its development; for while the virus, if injected into the thigh, was powerless, the same virus was found to be fatal if injected into the anterior chamber of the eye at one and the same time. Hence the products of the latter injection must have arrested the immunity in the muscles, and accordingly it may be concluded that the resistance of animals to infectious diseases can be effected by harmless as well as by pathogenic bacteria.—*Comtes Rendus*, cix (1889), p. 192; *Cf. Centralbl. f. Bakteriöl. u. Parasitenk.*, vii (1890), pp. 60-61; *J. R. M. S.*, April, 1890, p. 229.

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WASHINGTON MICROSCOPICAL SOCIETY.

107th Meeting, May 27.—The following was the program for the evening: Exhibition of Class Microscope, with remarks on its use with beginners in zoölogy and botany, by Mr. Richard Foster.

Exhibition of some "home-made accessories:" bulls-eye lens, warm stage, eye-shade, catalogue-holder, by Mr. L. M. Mooers.

MEDICAL MICROSCOPY.

By F. BLANCHARD, M. D.,

WASHINGTON, D. C.

Bacteria and their Products.—In bacteriology the scientists of the present day are doing such work as Linnæus did in the domain of phænogamic botany. We are discovering new forms, observing, describing, and reaching out towards a system of classification. The subject is many-sided and the study fascinating.

No other phase of this work is of such intense interest to the thoughtful physician as that which relates to the by-products of bacterial growth and their rôle in pathogenic processes. For some time it was held that the presence of bacteria within the body of the host was directly productive of disease. Then it began to be suspected that the ptomaines and leucomaines generated by the growth of these minute plants was the causative agent in producing the so-called zymotic diseases. Which of these views is correct? This is the question which bacteriologists are trying to answer.

If we could inject into the blood of a patient in the second week of typhoid fever a harmless germicide which would at once destroy every branch and spore of the bacillus of typhoid fever, would that abort the disease, or might the patient still die in coma from the narcotic effect of the alkaloidal substance already generated?

If these alkaloidal by-products are the real foe to health and life, then we may administer drugs, not to kill bacteria, but to antidote the alkaloidal poison. The bacteria, having exhausted the soil on which they at first flourished, will die and be excreted, and the patient will recover.

For the present all we can do is to experiment, collate facts, and think. It is certain that the blood of animals suffering from such diseases as charbon, does contain a very powerful chemical poison. It would be of value to learn whether the blood contains a less proportion of this poison in a mild case than in a severe case. Aurep obtained such a poison (Prof. John A. Miller in *Buffalo Med. Jour.*) from the brains of hydrophobic rabbits. The effect of small doses of this poison corresponded to the first stages of hydrophobia, and of larger doses to the latter stages. Behring claims that iodoform is valuable, not because it is a germicide, but because it is a chemical antidote to the ptomaine cadaverine.

At first thought we should prefer to be inoculated with cholera germs rather than with cobra poison; but the natives of India use the cobra poison in treating cholera, and Surgeon-General Hamilton has lately shown that the cobra poison is fatal to cholera germs. The Homœopaths also use the poison of the lance-headed viper in treating cholera, and the poison of a species of rattle-snake in yellow fever. Possibly these poisons are of value, not as germicides, but as antidotes.

Diphtheria.—Recent investigations by Babes, Piscariu, and Max Beck (*Zeit für Hygiene*, vol. viii, part 3d), strongly confirm the theory that the bacillus of Lœffler is the specific cause of diphtheria. The two former experimenters produced true diphtheria in doves by inoculations with pure cultures of this bacillus. Beck, of Tübingen, examined the mouths and throats of 66 healthy children, and of 64 other persons who were sick with follicular angina and other diseases of the throat, mouth,

and face, not diphtheritic. In none of these 130 cases was the bacillus of Lœffler found, while in 52 cases of well-marked diphtheria the bacillus was found in all.

Tetanus.—Faber has endeavored to isolate the bacterium of tetanus, but even when using the method of anaërobic growth, he only succeeded in cultivating two distinct species of bacteria together; one of these must be the true tetanus bacterium, as an inoculation from these cultures invariably produced tetanus. These two bacteria are found both in pus from tetanic patients and in the earth. Of 23 specimens of earth examined, 16 contained these bacteria, which are only found near the surface, not seeming to live more than a meter below the surface. A sample taken from the soil of a forest contained no tetanic bacteria. By cultivating a sample of earth for from 5 to 6 days, with a temperature of 98.6° in fluid serum and in vacuum, Faber obtained an exceedingly virulent culture. By filtering this through a Chamberland filter he obtained a clear, yellow liquor, containing no bacteria, but capable of producing tetanus by injection under the skin or into the veins of animals (rabbits, mice, etc.). It is curious to note that there was a time of incubation after the injection, varying from a few hours to several days. When the period of incubation was very long the animals ordinarily recovered. Faber does not think the poisonous principle the same as Brieger's tetanin. He has collected 64 cases of tetanus caused by wounds and treated in the hospitals of Copenhagen. In 26 of these an infection with earth was either proved or thought probable.—*The Satellite*, May, 1890.

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Disinfection by Burning Sulphur.—The proposal to discard the fumes of burning sulphur as a disinfecting agent meets with a vigorous remonstrance from Dr. Henry B. Baker, Secretary of the Michigan State Board of Health.

It seems that the health officer of Detroit had decided to discard this method of disinfection. In a circular addressed to him, dated August 7, 1890, Dr. Baker insists that the method should not be cast aside on account of a few laboratory experiments of apparently adverse significance, in face of the success that has attended the method in actual practice throughout the rest of the State.

By several tables and diagrams he shows how efficient isolation and disinfection have been in controlling outbreaks of diphtheria in Michigan during the past two years. He thinks that failures to disinfect with sulphur are due to using too little sulphur.

The burning of three pounds of sulphur to the thousand feet of airspace is sufficient to destroy the germs of contagious disease in a closed room, without extra moisture in the air.

In support of his position he quotes the results obtained by recent French experimenters in this field.

Certainly Dr. Baker's estimate of the value of sulphur fumigation corresponds with our own, based upon clinical observation.

EDITORIAL.

Unmanly Criticisms.—It happens to be the opportunity just now to say that if there appears in this *Journal* any paper to which our

readers or others take exception, the critics are invited to send their criticisms to us. If the criticisms are just and serve to correct manifest errors, or to throw new light upon disputed questions, and if they are written in a manly and courteous spirit, they will be published. It happens, however, that recently some criticisms have been indulged in which cannot command the respect of honorable men. An article has recently been published in a Western newspaper in which the writer took to task one of the prominent members of the Washington Microscopical Society for alleged errors in a paper read here in June, as to the date when vaccination was discovered, etc. The tone of the article was offensive and personal. It could not have gained admittance to any publication except a newspaper, whose editor was very unfamiliar with microscopy. The writer dared not offer the article before the Society itself. Had the criticisms, however, been couched in unoffensive language and seemed free from personal enmity, we should have been glad to print them. What pleasure a microscopist can take in thus attacking a brother microscopist anonymously and in the dark, we fail to imagine. The study of science apparently does not foster brotherly love. We regret that it should be so. The best cure for it is to offer, as we do, to print criticisms which are fair and just.

BOYS' DEPARTMENT.

How to Study Pond Life.

BY A. H. BRECKENFELD,

SAN FRANCISCO, CAL.

[Read at the Microscopical Society, Aug. 13, 1890.]

We know that beneath the miniature wave of the running brook, the quiet pool, or the wayside ditch, there may be found a fauna and flora, almost or quite invisible to the unaided eye, which rival the denizens of the field and forest in beauty and diversity of form, and variety and brilliancy of coloring. The study of Pond Life is a line of investigation inexhaustible in extent, easy of pursuit, and fascinating in the extreme, not only to the scientific worker, but also to the casual and unskilled observer. To pursue it you need not go far afield, for even the water-tanks on your housetops, or a muslin filter attached to your kitchen faucet will furnish an incredible abundance of animal and vegetable life. The small ponds and ditches scattered about the city will furnish other and more numerous forms.

In undertaking an expedition in search of pond organisms, the equipment can be made as elaborate or as simple as may be desired. A few wide-mouthed bottles with some sort of a dipping net, and a pocket magnifier are an absolute necessity, but this simple outfit may be expanded into the elaborate apparatus sold by dealers in microscopical supplies, done up in morocco case and shoulder-strap to aid in carrying it. A few yards of cord with a three-pronged hook attached may be advantageously used in bringing to shore floating masses or clumps of weeds, which look promising. In the absence of the hook three or four nails or a pebble to which the cord is attached will serve the same purpose.

The best method and the places for finding various minute organisms

depend upon the kinds sought. Some are found only in the ooze at the bottom of many pools, while others float freely at or near the surface. The under surfaces of partially submerged boards or branches are favorite habitats of polyzoa, sponges, and other beautiful and interesting organisms. Some affect the shade, while others are scarcely to be found except in warm and sunny spots. A little experience will soon teach one the favorite haunts of the more common microscopic plants and animals, and the acquiring of this experience is no tedious drudgery.

It is a remarkable fact that micro-organisms in general and the denizens of ponds and ditches in particular are wonderfully cosmopolitan. The microscopist travelling in Asia, in Africa, in America, or in Australia, if he "takes a dip" from some wayside pool, will be almost certain to find forms identical with or very similar to those with which every reader of European microscopical literature is familiar. We have every reason to believe that nearly all the wondrously beautiful inhabitants of the microscopic aquatic world are to be found in our streams and pools; and yet such objects as *Stephanoceros*, *Hydrodictyon*, *Clathrulina*, *Pectinatella*, and *Volvox* are still unknown to California microscopists. This is a deplorable and rather mortifying fact, but on the other hand the knowledge that such prizes are awaiting the earnest explorer should stimulate us in the search.

The most admirable monographs on microscopical subjects we possess are those devoted respectively to the Rotifera, the fresh-water sponges, the Rhizopods, the Infusoria, the Ertomostraca, the fresh-water Polyzoa, the Desmids, the Diatoms, and other fresh-water algæ, all denizens of ponds and ditches. Besides the splendid treatises on the foregoing classes, "Pond Life" has been made the subject of several popular works of low price but good quality. The best of these is "Microscopy for Beginners," by Dr. A. C. Stokes.

A pleasant feature of the study of pond life is the facility with which material for work can be obtained and preserved. The contents of a few small vials may be used for stocking several small aquaria, which need be nothing more elaborate than ordinary tumblers or goblets. A little experience here will teach one how to avoid over-stocking with vegetable life and preserve an even balance with the animal. It will only be necessary to add a little fresh water from time to time, to make up for evaporation, to preserve the inhabitants for weeks or months. These miniature aquaria should have plenty of daylight, but very little direct sunlight.

Mr. Breckenfeld urged his hearers to make an occasional collecting trip in search of the interesting organisms with which our fresh-water lakes, ponds, and streams are teeming. It will furnish an inexhaustible storehouse, from whose supplies one can always draw abundant material for recreation or study. The most of us, he said, are busy men, and the day's duties are often both wearying and worrying. Here is a chance for genuine rest, for real recreation. As one sits in a cozy room, by the soft light of a shaded lamp, and sees in the bright circle of the microscope's field of view the fascinating drama of miniature life there presented; as one watches the sweep of the beautiful *Floscule's* wheel, and the mysterious procession of granules in the little Desmid's cell, our own worries and troubles seems to diminish—the pleasant hours glide swiftly along.

MICROSCOPICAL SOCIETIES.

SAN FRANCISCO, CAL.,—W. E. LOY, *Sec'y.*

August 13, 1890.—A paper on "Pond Life" was read by A. H. Breckenfeld; living objects were shown under the microscope. Several members had brought in their stands, and nine microscopes were placed on the tables. Professor E. S. Runyon, of the College of Pharmacy, had his oxyhydrogen microscope on exhibition, and the image of the more interesting "dips" was thrown on the wall in a much enlarged form. There was successfully shown several species of the *Rotifera*, including *Brachionus* and *Vulgaris*, a very fine gathering of fresh-water worms, and an endless variety of Infusorians, including the beautiful *Euglena viridis*. There was also a respectable showing of the various species of fresh-water algæ, in fruit and in conjugation.

August 27, 1890.—In addition to members, Dr. Edward Gray, of Benicia; Everett M. Hill, of Napa College, and J. O. Whitney, of Oakland, were present as visitors.

The committee on the proposition to take rooms in the new Academy of Sciences building on Market street, reported adversely.

The meeting nights of the society were changed, by an amendment to the constitution, from the second and fourth Wednesday evenings to the first and third Wednesday evenings in each month.

Henry G. Hanks presented a paper descriptive of a very rare and beautiful specimen of crystalized gold.

September 3, 1890.—This was the first meeting under the change of time of meeting, and the attendance was light.

Henry G. Hanks called attention to a very old reference to lenses, or magnifying glasses, which he recently found in an old work, "The Vanity of Arts and Sciences," by Henry Cornelius Agrippa. The edition shown was an English translation, published in 1676, from the original Latin edition, published in 1527. The reference alluded to reads thus:

"So we read, as Cælius in his ancient writings relates, that one Hostius, a person of an obscene life, made a sort of glasses, that made the object seem greater than it was, so that one finger should seem to exceed the whole arm, both in bigness and thickness."

It was found that Cælius Antipater (to whom Agrippa probably refers) was a Roman historian who lived 125 years B. C. He wrote a history of the first Punic War, only parts of which were extant. So far as known, this was the first account of magnifying glasses in history.

Henry Cornelius Agrippa, the author of this curious old book, was born at Cologne in 1486, and was a man of talents, learning, and eccentricity. In his youth he was Secretary to the Emperor Maximilian, and was knighted for bravery in Italy. On quitting the army he devoted himself to science, and made pretensions to an acquaintance with magic. In 1530 he wrote his treatise "On the Vanity of the Sciences," which was a caustic satire upon the inefficiency of the common modes of instruction. After an active, varied, and eventful life he died at Grenoble in 1539.

NOTICES OF BOOKS.

The Industrial Revolution of the 18th Century in England. By Arnold Toynbee. Humboldt Publishing Company, New York (Price, 60 cents.)

The point of view of the author of this important work is that of one who, while he admits the benefits conferred upon mankind by the old school of political economists—Adam Smith, Ricardo, Malthus, and the rest—believes that their work is done, and that the world has got beyond them, and stands in need of something more. The work is a history of “the bitter argument *between economists and human beings*,” to use the striking phrase of his chapter on “Ricardo and the old political economy.” When the economic relations of men are studied by an observer who, to abundant learning, adds the quality of human sympathy, the result is no “dismal science.” Besides the treatise named above, the present work contains three popular addresses on “Wages and Natural Law,” “Industry and Democracy,” and “Are Radicals Socialists?” as also papers on “The Education of Co-operation,” and “The Ideal Relations of Church and State.”

SUBSCRIBERS' NOTICES.

[These notices will be given six insertions in this column at 25 cents per line or fraction thereof.
FOR EXCHANGE.—Slides of selected diatoms. D. B. WARD, Poughkeepsie, N. Y.

OFFERED.—Diatomaceous Earth from Utah (Desert) for Histological Mounts.
PROF. ORSON HOWARD, Salt Lake City, Utah.

CORRESPONDENCE invited with a view to the exchange of either mounted or unmounted Oribatida (British) for American species. E. BOSTOCK, Stone, Staffordshire.

WANTED.—Any works on Microscopy not already in my Library.
H. M. WHELPLEY, F. R. M. S., St. Louis, Mo.

First-class Histological Slides for other good mounts; Histological and Pathological material cut on shares.
S. G. SHANKS, M. D., 547 Clinton Ave., Albany, N. Y.

WANTED.—A clean copy of Wolle's Fresh-Water Algæ of the United States (2 vols.); also good second-hand Grunow Camera-Lucida, and a self-centering Turn-table.
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FOR SALE.—Beautiful photo-micrographs of *P. angulatum*. Only 25 cents each.
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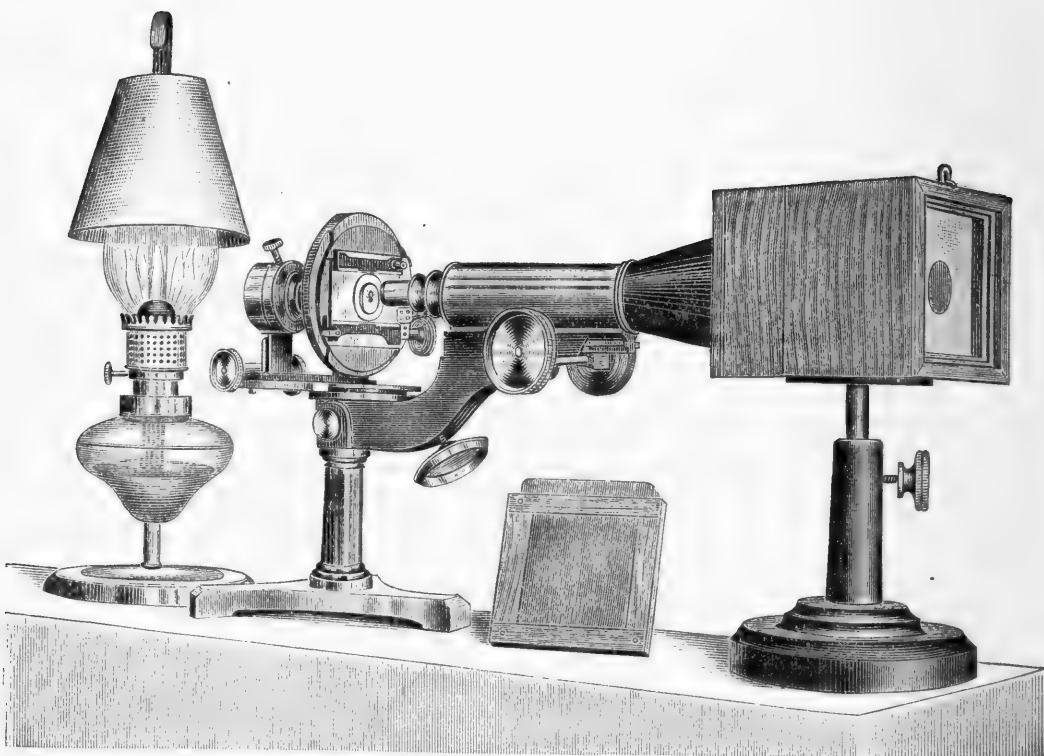
WANTED.—Proceedings Am. Acad. Sciences, XI, 1876.
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DR. J. E. BAKER, Wyoming, Ohio.



THE HANDY PHOTO-MICROGRAPHIC CAMERA.

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Microscopy for Amateurs.

By T. CHARTERS WHITE,

QUEKETT CLUB.

[Continued from page 223.]

Forceps.—The cover-glasses after cleaning are best kept free from stains by being handled with forceps; this plan also enables the operator to lay the cover-glass over the object without disturbing its surface so much as if clumsily laid down by the fingers. Forceps are of two kinds, curved and straight, both being found very useful in the preparation and mounting of microscopical objects.

Scissors.—Two pairs of these will be found of great service in the preparation of microscopical objects. They should be small and delicately made, and kept beautifully bright and free from rust. One pair should be straight, while the other should be curved sideways, but both coming to fine points. Another pair may be added to these, but much smaller and more pointed, with a spring between the handles to keep the blades apart when not in use. This will be an indispensable advantage in the dissection of insects.

Needles.—These are useful in laying out membranous or other thin subjects, so that they may be as free from creases as possible, or for removing stray particles of foreign matter which, if allowed to remain, would detract from the cleanness and beauty of the mounted preparation. They may be made very easily by drilling holes in wooden penholders, and inserting ordinary needles, some may have a stout bristle instead of a needle—needles may be either straight or curved—where it is necessary to use acids, needles of glass may be made by melting a thin rod of glass over a spirit lamp and pulling out a fibre of it to the size required, this glass needle will be found very useful where chloride of gold is employed as a staining fluid, as metal needles cause a deposit of the gold and a dirty stain wherever the specimen is touched. If steel

needles are prepared—and some descriptions will be found of great service later on—they may be coated with gold by shaking up an aqueous solution of chloride of gold with sulphuric ether, which, taking up the gold from the solution, will deposit it on any steel which comes in contact with it. When the needles are broad and flat, such as are used by surgeons, they may be mounted in a handle, ground and sharpened, highly polished, and gilded with this solution, they then form excellent scalpels for the minute dissection of insects, and the gold coating prevents their contracting rust, which, catching in the delicate fibres of a partly dissected insect, would spoil several hours' work.

Wash Bottle.—This is a very useful appliance in many microscopical operations; it is readily made by taking a wide mouthed well-corked four-ounce bottle, then perforate the cork in two places, pushing through two tightly fitting glass tubes; the one reaching to the bottom of the bottle may be softened at a point just above the cork by holding it in the flame of a spirit lamp, and bent to an acute angle of 70° , its outer end melted and drawn to a point which may be chipped off according to the dimensions of the exit required. The second tube, which will constitute the mouth-piece, may be pushed only just through the cork, and its outer part bent to an obtuse angle of 120° . By partly filling this bottle with distilled water and blowing through the mouth-piece, the pressure of the air on the surface of the water forces it through the other tube, and it may be directed in a fine stream, but with considerable force, against any section or other substance it is desirable to wash. Similar bottles may be made to hold glycerine, salt solution, or any of the mounting fluids to be treated of later on.

Watch Glasses.—The student is recommended to get about half a dozen of these; they are used for soaking specimens in staining fluids and for holding isolated specimens. There are some glass pots having lids about the same size as watch glasses, which are very handy and inexpensive.

Wine glasses which have become broken from their stems are useful for placing over preparations which may be soaking in spirit or staining fluid, if the operator is called off or has to leave his work for something, as they ward off dust and check evaporation.

Dipping tubes and stirring rods may be obtained of any chemist and cannot be dispensed with.

It is sometimes necessary in warming slides when mounting in Canada balsam, or in making troughs with marine glue to hold them over a spirit lamp. It is not comfortable to do this at the risk of burnt fingers, and therefore this may be done more safely and easily by holding the slide in a pair of wooden forceps constructed as follows: Take two strips of deal of about equal length and thin them off at one end, between the thick ends glue in a small block of wood, and, if necessary, tack the slips to make them more secure. This will be found a useful accessory for this purpose, and moreover the glass is not so likely to fly with the heat as if held with metallic forceps.

Having furnished himself with these indispensable appliances, the student may proceed to make such simple investigations as his immediate surroundings may furnish. The more simple and elementary they are the more sure will be his progress. An examination of such an easily obtainable subject as a drop of saliva will afford very instruc-

tive lessons in the flaky masses of flattened epithelial scales filling the field of view. The immense number of round dark rings are air bubbles, which once seen in this fluid will be readily recognized whenever met with afterwards. The drop of saliva being placed on the slide, the cover-glass is gently picked up in the forceps by one edge while the opposite side is lowered on to the fluid and allowed to fall by its own weight. All fluid mountings should be accomplished in this manner.

Simple Examinations.—Microscopical subjects may be divided into opaque and transparent, both subdivisions teeming with interest, but requiring different treatment in their examination. The examination of opaque objects requiring less preparation than those of the transparent subdivision may well occupy our consideration in the first place. Having a glass slide on which the opaque object is placed, it is only necessary to throw the rays of light on it with the condensing bull's-eye lens supplied with the microscope and examine it first with the lower power, and when all its general appearance is mastered then using a higher power lens to investigate the detail of its exterior. We are not able in the examination of this class of object to do more than gain a knowledge of its external characters; nevertheless the student will find abundant material in it to interest and instruct. It may save him trouble and be suggestive, if he commences his observations with such as may be found in the following list, viz., minute animals, such as cheese and other mites (*acari*).

Poduræ.—Little silvery animals generally found abundantly in fern cases and amongst moss, or under damp stones or tiles in the garden, where they may often be found in company with a little light brown pseudo-scorpion called *chelifer*. In the examination of this class of object it is very necessary to employ a cell. A cell is anything which can imprison and confine, and a microscopical cell may be constructed of any material by which you can form walls either circular or square to be roofed in with a cover-glass, for by this means you are enabled to restrain the peregrinations of your menagerie. If many chelifers are confined together, they will quickly mutilate each other, and even one kept in a cell has been known in its futile rage and despair to tear off its own pincers or its legs. As the *arachnida* to which they belong include on the one hand the scorpions and on the other the spiders, we may naturally look for something rapacious in their habits, minute as they may be; these are but few amongst many instances which might be given, but it will be sufficient to indicate these few as suggesting the line of observation the student may take with advantage. Whole insects or parts of them may be submitted to examination. One suggestion may be in the direction of looking at the eyes of flies of various kinds, or their mouths or proboscis, and it affords a very interesting study to imprison a bluebottle fly in a small paper cone, the apex of which has been cut off sufficiently to allow the fly to pass its head and proboscis through, when it is generally fixed, and not easily withdrawn until the cone is undone. This method will exhibit in an interesting manner the working of the proboscis or so-called blowfly's tongue, the contraction and expansion of its disc, showing the horny chisel-shaped teeth which lie on either side just within it. A live flea may be put under a wine glass on some blotting paper with a few

drops of chloroform. The flea being rendered insensible, may be affixed by a minute drop of gum on its side to a white card. By the time the action of the intoxicant has passed off the gum will be dry and the drunkard will find herself in a fix, and in her endeavors to walk home will display the action of the legs and oral apparatus. These are but suggestions to direct the ingenious student to devise other ways and means for observing the various parts of living insects. One of the most ingenious as well as the most useful appliances to be used in connection with opaque living objects is a cork cell which is constructed in the following manner: Take a slip of cork such as is employed to pin insects out in museums, cut it to the dimensions of a microscopical slide, then cut an oval hole with slightly tapering sides through its centre, and about one inch by three-quarters of an inch; place glass slides under and over the cork, interposing a pad of wet blotting paper between the bottom glass and the cork, and bind all together with two elastic rings. Any such small animals as *poduræ* and congeners kept in these cells in the damp and fed on oatmeal will thrive and multiply besides always being ready for examination when wanted; thus their life-history may be traced and their habits watched.

Mounting Opaque Objects.—The student may be desirous of mounting some opaque objects for future reference and investigation, and, to preserve them, they must be mounted in cells of a suitable depth—microscopical cells are square, oblong, or circular—according to the shape and size of the object to be preserved. If the square, or oblong cell is chosen, slips of glass of a suitable thickness, and rather more than $\frac{1}{8}$ inch in breadth, may be procured from any glazier; with short pieces of this the cells may be built, the slides being affixed to a glass slide with warm marine glue; when cold the superfluous marine glue may be cleaned away, and the bottom of the cell obscured with a black varnish, such as Brunswick black. or it may be painted with India ink, as it is desirable that no light should be transmitted through the cell in examining opaque objects. When the cell is thus far constructed, it should be set aside to become thoroughly dry, or a most annoying dew settles on the inside of the cover-glass, rendering the object indistinct. The author has often found it useful, in these cases, to leave the cover-glass temporarily fastened down, by tacking it in two or three places with some wax, with which a small quantity of Canada balsam has been incorporated, to make it more adhesive. The cover then is sufficiently fastened for safety, at the same time excluding dust, while it can be removed at any time should it require cleaning. This mixture of wax and Canada balsam will be found extremely useful in many ways later on, and several ounces might be prepared in readiness for future use. In mounting very thin opaque objects, which do not need a cell of any depth, it is sufficient to cover them with a circular glass, and by means of a smooth, round piece of iron or brass rod made hot, to run some of this wax preparation round in the angle formed by the edge of the cover-glass and the slide, when, on touching the cold glass, it sets and seals the edge allowing a coating of varnish to be immediately placed on, for greater security and permanence, without the danger of its running in and spoiling the object.

Subjects requiring but a slight addition of depth beyond that sufficient for the last class of objects, may be mounted in a varnish cell.

A ring of some hard varnish, such as that made of gum dammar, dissolved in benzole, is made on a glass slide by means of a turn-table, and when sufficiently hard, the object may be mounted within it. The cover-glass being chosen rather smaller than the ring, may then be fastened on with the wax and Canada balsam before a permanent cement is put on, or there is great danger of the cement being drawn in by capillary attraction, and the preparation spoiled. Neat glass cells may be constructed in the following manner: Take a brass plate having circular apertures in it of the size the cells are required to be, and with marine glue cement a square of thin glass over one of the selected holes. When the glue is quite hard, give a smart puncture in the centre of the glass with a small rat-tail file, when the brass will be starred, the cracks, however, not proceeding beyond the edge of the aperture. The glass may then be filed out under water to the edge of the aperture. Great care must be exercised afterwards, in warming and removing the glass from the plate, though if a simple fracture should occur, it is of no great consequence, as the cell joins again readily when cemented to the glass slide.

It may sometimes be useful to cut a hole through the slide itself, which may be accomplished in this fashion: Take a hard steel drill, having a spear-headed point, dip it in turpentine, and drill partly through the surface of the slide at the point opposite to that in which the cell is to be made; then attack the other surface, so that the hole made shall correspond to that already begun, and by the application of fresh supplies of turpentine, continue the drilling until the point comes out at that first commenced, when the drill comes through without cracking the glass or starring its surface. Having got the hole, it may be enlarged by the use of the rat-tail file under water, to the dimensions required. Where it is desirable to examine test objects through thin glass, this may be cemented over such a hole, and the test object mounted on it in the ordinary way, and covered with a similar piece of cover-glass.

Glass rings, corresponding in dimensions with the diameters of the most generally employed circular covering glasses, are exceedingly valuable for mounting opaque objects. They may be cemented to the glass slide with marine glue; their surfaces being left rough from the cutting afford a firm attachment for the glue, which diminishes the risk of the ring coming off the slide with too energetic wiping. Rings of pure tin or zinc can also be obtained, and are useful from the ease with which they can be reduced in depth by filing, should they be too deep for the object to be mounted. Rings of gutta-percha, vulcanite, and millboard, have found favor with some; but their qualifications for making a sound and secure mount have been so deficient that they have been discarded by all good mounters. Brass rings are not suitable as the copper in them stains the mounting medium green after the preparation has been set up a short time. There are some cells termed ground-out cells, which can be highly recommended to those who mount small insects as transparent objects; they may be had of different sizes, to suit different objects. They are as the name implies ground out from the surface of the slide, and afterwards polished. For mounting those objects which show their points of interest to the greatest advantage without pressure, they are most

satisfactory. Having treated of those cells most usually adopted, we are now ready to pass to the various cements employed, both for fastening the cells to the slide as well as the cover-glass to the cells.

Marine Glue.—Nothing can surpass the utility this cement presents, whether in the tenacity with which it holds, or the readiness with which the cells or troughs for the examination of aquatic life can be constructed; it is the most suitable and convenient the microscopist can employ, as, by its aid, he can join glass and metal in any variety and form his requirements may suggest. To melt it gentle warmth must be used, but the temperature must not be sufficient to burn it, or its adhesive properties are destroyed. However valuable it may be for the purposes here indicated, it is not adapted for cementing cover-glasses. For that we require a varnish which can be put on without heat, and of this kind we have a variety to choose from. Whatever varnish we use as a cement must not be too thin. It ought to be of the consistency of syrup, or that of the densest and freshest glycerine. If it is firmer than that, there is a difficulty in sealing up a preparation so that the joint is solid and free from leaks. If it is thinner than that, there is the danger of its running in; but if it is of about the firmness indicated, these liabilities are greatly lessened, if not entirely abolished.

Gold Size.—This is by far the best cement for this purpose, for a cement should not become hard too quickly. It is better that it should take a day or two after a first *thin* application, before it is sufficiently set as to allow of a second and thicker coating. This cement answers well for sealing up cells containing any of the preservative fluids but especially for those not containing glycerine. Glycerine is influenced greatly by changes of temperature and barometric pressure. It is also hygroscopic, therefore moisture is readily absorbed by it; so, if the cement is cracked by the expansion of the glycerine, moisture is soon absorbed, and, swelling the fluid contents of the cell, causes a general bursting of the cement. The author has found the value in glycerine mounting, and with other preservative fluids as well, of an addition to the gold size of about one-third solution of India-rubber in benzole. This gives an elasticity to the gold size, which seems to allow of a small amount of expansion without cracking the cement. The older the gold size the more reliable it is as a cement.

Gum Dammar Varnish.—This is a clear, tenacious cement, which may be readily made of any consistency desirable. By putting clear pieces of the gum into benzole, and, when dissolved, letting the benzole evaporate till the fluid is of the density required, it may be decanted off into small bottles for use. It dries very readily, and a thin coating put round a cell is sufficiently hard in a couple of hours to receive an additional one. There are several other cements more or less recommended, but the student will find in these two all that he needs to meet his requirements.

Mounting Transparent Objects.—*Preservative Media.*—These are of two kinds—the solid, such as Canada balsam and glycerine jelly; and the fluid, as glycerine. Canada balsam, while undoubtedly that which takes the first place, especially with novices, in the art of mounting, on account of the apparent simplicity in its use and the readiness with which a slide can be prepared by its means, has its drawbacks; and perhaps the first which the student will experience is

that arising from the presence of air-bubbles ; but this liability can be overcome by placing the object to be mounted on a small portion of Canada balsam, previously put on the slide, and then dropping another small portion on the centre of the cover-glass, and upon bringing the two carefully together with the aid of the forceps, the air is excluded. While Canada balsam is an extremely useful agent in various degrees of age and hardness as a mounting medium, it will be found more useful if thoroughly hardened and redissolved. Take it as supplied by dealers, and pour it into a glass and evaporate it by heat, till, upon dropping a little into cold water it is found to set hard like a piece of resin ; it may then be set aside to cool, when it is ready for solution. Two solvents have been recommended—chloroform and benzole. Of these two the author prefers the latter, and advises its use because after solution in this it becomes very limpid and colorless, any foreign matter in it soon settling to the bottom. It should be kept for use in a capped bottle, and it after a time it should become stiffer, it may be diluted with a little benzole. One great advantage of this solution is the readiness with which air-bubbles in it disappear after a few hours. The slide and preparation may be plentifully covered with them, but they soon become absorbed, and finally the preparation is quite free from them.

Glycerine Jelly, a very uncertain preparation ; after a time large air-spaces develop in it, probably the result of desiccation. The object to be mounted must be previously well soaked in glycerine. Air-bubbles are very liable to accompany its use, and they are difficult to get rid of by reason of the tenacious character of the glycerine.

While Canada balsam and glycerine jelly readily lend themselves to the mounting of such preparations as are substantial in their character, as are the sections of different tissues, hard and soft, there are other preparations as dissections of insect anatomy and delicate objects, both animal and vegetable, which would be crushed out of all recognizable shape by the pressure necessary in using such comparatively hard mountants as these ; therefore recourse is had to fluid preservative media, to which attention may now be directed.

In using these it is well to bear in mind the necessity of considering the density of the fluid medium, that it bear a proportionate relation to that of the preparation to be mounted ; for instance, a delicate object, especially if of a tubular character, would collapse and be crumpled out of its proper shape and probably spoiled by being placed in dense glycerine, but by altering the density of this by dilution the character of the preparation can be preserved. Thus glycerine is a favorite mountant from its adaptability to almost all objects, and the facility with which it unites with other chemicals ; nevertheless, it needs discrimination in its use. It cannot be employed for calcareous tissues like bone or shell, as they would become decalcified after being exposed to its influence for some time ; therefore, for these preparations only balsam should be used. Glycerine used in its full strength is highly refractive, and is thus useful in bringing into view the minute details of many structures. Objects to be preserved in dense glycerine should first be soaked in a diluted solution and passed through solutions of increasing density till that of the original glycerine is attained ; in this way all risk of distortion is averted. Glycerine diluted with camphor water makes an excellent preservative fluid ; but one which finds much favor with mi-

croscopists and is useful for the majority of preparations, is made from a mixture of glycerine one part, water two parts, and alcohol three parts, commonly known as the one-two-three mixture. If it is desired to render an object transparent, it may be soaked in this mixture and lightly covered up to protect it from dust, when the alcohol will evaporate, leaving the glycerine and water in the tissues.

There is one disagreeable drawback in glycerine as a preservative, and that is, the difficulty of cementing it in securely. It needs great care and scrupulous cleanliness in its use; but this may, to a great extent, be acquired by employing as frequently as possible the same size of cover-glass, when, by practice, the amount of glycerine which will be sufficient to flow to its edges without extending beyond, may be accurately judged. A cement may then be applied which will keep the glycerine in. If any flows beyond the edge it may be taken up with blotting paper, and cleaned away; but it is difficult to make any cement stick to the slide securely when it has been once wet with glycerine. Several plans have been suggested and adopted to overcome this difficulty; one of which seems to answer fairly well. It consists in drying up the glycerine as thoroughly as possible, and painting around the edge of the cover a thin layer of glycerine jelly. When this has set, any of the usual cements may be laid over it. A cement to be used for glycerine mounting, and which is said to be very easily applied, and to stand very permanently, is made as follows: Carbonate of lead, two drachms; red oxide of lead, two drachms; litharge, three drachms, to be well mixed and powdered. When wanted for use, mix only enough for the mounting with a little gold size and apply at once. This cement is also spirit proof. There are many plans suggested for overcoming this difficulty. The employment of these two cements, and the mixture of gold size and india-rubber solution already given, will be found amply sufficient to meet all demands.

There are other preservative media, which, next to glycerine, are comparatively easy of employment, such as alcohol and distilled water, camphor water, syrup, etc.

Alcohol is well known as a preservative, but it has so great a tendency to render delicate tissues opaque by coagulation, that for microscopical mounting purposes it is never used in its full strength. A preservative fluid should interfere as little as possible with the normal characters of a preparation, and should be what histologists designate as an indifferent fluid. Some beginners might think that distilled water ought to answer to this character, but it does not, and should only be used for the most transient examination. One may prove this statement by the examination of blood corpuscles in water, and he will soon see them changed into every shape but their normal one. That water may be used for even a casual examination it is necessary that it should be combined with some other substance that will give it a specific gravity equal to the liquids contained in the tissue under examination. For this purpose a weak solution of common salt in water is employed, and answers fairly well. It gives its best effect if a little gum arabic is dissolved with it. A stock solution of it may be made by dissolving one drachm of common salt in a pint of distilled water, and adding four grains of gum arabic; this is then always ready for use, should immediate examination be necessary. This forms a very fair

and stable mounting medium, so that in the event of the object under examination proving of interest, it will only be necessary to let the fluid be dried up around the edge of the cover-glass when it may be cemented with gold size or stiff gum dammar varnish.

Another useful fluid mountant will be found in a nearly saturated solution of acetate of potash. It is found valuable in the mounting of vegetable preparations. The preparation being placed on the glass slide under the cover, the solution may be added drop by drop till the intervening space is filled, when it may be sealed with cement. Its refractive powers are not equal to glycerine, but in cases where glycerine is not admissible, this will be found an excellent substitute.

Preservative fluids vary according to the substance to be mounted, whether it be vegetable or animal, whether the animal be marine or fresh water, and even different parts of the animal body require their suitable medium.

Whatever mounting medium be employed, nothing conduces more to success than neatness in manipulation and regularity in arrangement. And mounted specimens add considerably to the pleasure of keeping a cabinet if all the slides are correctly labelled, and no specimen should be put aside without a temporary label. If the student intends returning to it for further observation, it is hopeless to say it will be remembered. A month or two after, a doubt will arise in the mind, and six months after, its source, name, its very nature, are involved in obscurity. It will then be thrown away, for its usefulness as an instructive agent has vanished. A simple plan when preparing a series of slides is to have some of the gummed bordering of postage stamps rolled on a reel and hung up near the mounting table. When a slide is prepared and before placing it in the cabinet, put on a temporary label from this roll, write with pencil the name of the object, and any particulars relative to the mounting medium, etc. Not only should the slides be labelled, but it adds considerably to their neat appearance if the mounts are in the centre of the slide. It is sometimes not an easy matter, especially with delicate or fragile objects, to get them into this desired position, but, by gentle coaxing, or by a judicious floating on to the slide, if a thin section, it may be made to occupy the centre. There are, however, some substances whose constitution is sufficiently robust to stand a good deal of pushing about. A small piece of apparatus has been used by the writer for some years with satisfaction, and may be adopted with great advantage. Thereby the object may be centred with great facility. A thin plate of wood covered with white paper, and rather larger than an ordinary standard slide, should have a wooden ledge glued along one side, and shorter ones at the ends, thus enclosing an area which will receive tightly the glass slide on which the object is to be mounted. If two lines are drawn diagonally across this space from the opposite corners, their intersection will be the exact centre of the slide. Taking this intersection as the centre, circles corresponding to the size of the circular cover-glasses usually employed, may be struck with a compass, and in this way objects mounted within the circles seen through the glass slide must be centrally placed. It is desirable sometimes to be able to examine an object from both sides. It may be thus accomplished—procure two thin strips of wood of the standard size, from the centre of one cut out a square three-quarters of an inch side, from the other cut out a square seven-eighths of an inch side, glue the

two slips together, and it leaves a ledge for the preparation to rest on. Specimens, therefore, if mounted on glass covers seven-eighths of an inch square, drop into the frame or carrier, and can be turned and examined from each side.

Such are a few of those preliminary details which are necessary for elementary work. After having examined simple objects requiring no special preparation, one may pass on to those needing more complex treatment.

[*To be continued.*]

Protective Inoculations.

By B. M. BOLTON, M. D.,

BROOKLYN, N. Y.

[From Brooklyn Medical Journal, June-September, 1892.]

Pasteur was the first to make extensive experiments with a view to obtaining vaccines for protective inoculations for various infectious diseases. He was led to these experiments by Jenner's discovery of vaccination for small-pox, but it is evident that Pasteur's inoculations differ from vaccination for small-pox, for Pasteur uses cultures of the micro-organism, causing the very disease for which he inoculates. In vaccination for small-pox, as is well known, the infectious material of a disease similar to, but not identical with, small-pox is used. Pasteur's inoculations are, therefore, rather to be compared to the inoculations formerly in use where small-pox virus was used to inoculate with. The object Pasteur seeks to obtain is to so modify the infectious material that it will produce only a mild form of the disease in question. This problem is very difficult of solution, and the most serious obstacle is the variable susceptibility, not only of different races of animals, but also of the different individuals of the same species; infectious material which causes a mild attack of the disease in one animal sometimes—exceptionally, it is true—causing death in another animal of the same species. Although this difficulty has not yet been overcome the possibility of attenuating infectious material, so that it will produce only a mild form of disease, is well established. As yet these inoculations are of more interest from a scientific than from a practical point of view, at least in human medicine, and the practical utility of protective inoculations in animals is still an open question.

Pasteur found that the artificial attenuation of pathogenic micro-organisms can be effected in two ways. In the first place by the use of some agent injurious to the bacteria, such as heat, chemical agents, etc.; these cause, according to Flügge, a degeneration of the organisms, and the virulence returns in a longer or shorter time when the organisms are again placed under favorable conditions. In the second place attenuation may be effected by cultivating the organisms for some length of time under unusual conditions—for example, in the bodies of animals not susceptible to natural infection; the attenuation obtained in this way seems to be much more durable than that obtained by the first method and not so likely to be lost by cultivating the attenuated cultures under normal conditions. Besides the methods of inoculation with attenuated cultures, it has been attempted to render animals immune by inoculation of the products of the growth of bacteria, *i. e.*, the so-called ptomaines.

The first disease for which Pasteur obtained attenuated virus was chicken cholera. He found that cultures which had stood for several months exposed to the air, *i. e.*, merely plugged with cotton, had weakened in virulence. These old cultures produced on inoculation only a local abscess, which ended in resolution in a few weeks, but the chickens so inoculated were found to be protected from subsequent attacks and also from the disease by inoculations of virulent material. Pasteur attributed the weakened virulence to the action of the air, for he found that in cultures of chicken cholera which were sealed up, the full virulence was retained.

Pasteur's next successful experiments on attenuation were made with anthrax or malignant pustule. The method of attenuation in this case was different from that for chicken cholera. Cultures of anthrax bacilli were grown at 42° to 43° C., and it was found that these cultures were much less virulent than cultures grown at lower temperatures, and that animals inoculated with them were for the most part protected. Pasteur's inoculations for anthrax have been tested on a very large scale by different experimenters with various results.

The third disease for which Pasteur obtained vaccines was swine erysipelas (*rouget du porc*), an infectious septicæmia causing great ravages among the hogs of France. The method of attenuation in this case is to inoculate rabbits with virulent cultures. It is found that the micro-organism becomes attenuated after having passed through the body of a rabbit. Cultures obtained by inoculation from rabbit to rabbit finally become so attenuated that they will no longer kill. But cultures attenuated in this way protect hogs when inoculated.

Kitt has put all these methods of inoculation to the test. He found that vaccines for anthrax obtained direct from Pasteur were not capable of protecting the sheep he inoculated. He then inoculated guinea-pigs with the vaccine, and obtained cultures from these guinea-pigs which produced a fatal anthrax in sheep. The organisms had increased in virulence in passing through the guinea-pigs, and, although these cultures were virulent for sheep, they rendered cattle immune. But the fact that Pasteur's vaccines were sufficiently powerful to protect the sheep which Pasteur inoculated and were not capable of protecting the sheep which Kitt experimented with, shows the practical difficulty of obtaining cultures of just the right strength. Krajewski's results with the same vaccines were also unfavorable. Hess obtained rather more favorable results. Kitt found Pasteur's observations on chicken cholera to be correct, but strongly advises against the use of vaccination. He points out that the excreta from inoculated fowls is virulent for other animals, and, as in the case of anthrax and other bacterial diseases, the organism increases in virulence when passed through the body of susceptible animals.

Kitt's experiments with swine erysipelas gave similar results to those with chicken cholera. He substantiated Pasteur's observation that the virulence of the organism was weakened by its passage through rabbits; but the fæces from hogs inoculated with attenuated cultures were found to be virulent for other domestic animals and for birds. Hess and Guillebeau found protective inoculations for swine erysipelas unsatisfactory.

[To be continued.]

The Epithelium of the Brain Cavities.

By PIERRE A. FISH,

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The contradictory statements of various authors as to the existence of ciliated epithelial cells in the membrane lining the brain cavities, has been one of the chief reasons for pursuing this investigation.

For the practical purposes of this study the cat was chosen, because it is easily accessible and is a good representative of the class mammalia; furthermore, in the opinion of the writer, the morphological differences of these epithelial cells, in mammals generally, are less important than their resemblances. Special attention was given to the diacœle, mesocœle, and epicœle. Three stages were studied: at birth, at six weeks, and adult. Ciliated cells were found in all which resembled each other so closely in structure that the stages might easily be interchanged. For details high powers should be used; nothing less than 600 diameters will give satisfactory results.

Preparations hardened by Goule's method show the cilia quite well either when sectioned or after being teased. The epithelium in some places may be stripped from the adjacent tissue as a continuous membrane, and this, after remaining for a short time in some dissociating agent, may easily be teased apart.

The cells are very short, columnar in outline, and ciliated at their free ends, the long diameter of a cell including the cilia being 9μ . The cilia are *relatively* much longer than usual; they represent about one-fourth of the entire length, or 2.5μ . In hardened preparations they are not always perfectly preserved, often appearing to have been thinned out and broken off. A thorough injection of the hardening agent into the cavities will do much toward obviating this undesirable feature.

The nuclei, more or less oval in outline, nearly fill up the cell bodies. In none of the nuclei, stained or unstained, could nucleoli be detected, although numerous clear spots could be seen, particularly in the fresh specimens.

The cell-bodies send off one or more roots into the adjacent tissue and by means of them are anchored to their places. The neuroglia varies in thickness at different places: under a high power it has a wavy, homogeneous, and slightly fibrous appearance in which are scattered neuroglia cells. It passes imperceptibly into the true nervous substance as a connective medium, binding together nerve cells and fibres.

The propulsion of the cerebro-spinal fluid through the cavities, if cilia are absent, may be accounted for by the brain movements stimulated by psychical, circulatory, and respiratory influences. In the embryonic stage where these influences are, not yet or only about to be, developed, cilia abound.

This investigation has demonstrated the existence of ciliated epithelium in the endyma (lining membrane) of the adult as well as earlier stages of the cat.

If psychical phenomena are not incompatible with the presence of endymal cilia and if the brain is treated while perfectly fresh, there seems to be no good reason, from a morphological stand-point, why cilia should not likewise exist in the endyma of the human adult.

A Handy Photo-Micrographic Camera.

By W. H. WALMSLEY,

PHILADELPHIA, PA.

[Read at the Detroit Meeting, 1890.]

Although photography in conjunction with ordinary microscopical observations (in other words, photo-micrography) has undoubtedly grown in usefulness and popularity among workers with the microscope during the past five years, there can be no doubt that its aid is very sparingly employed—a fact greatly to be regretted. For it is quite self-evident that the value of any microscopical research would be greatly enhanced, not only to the observer himself, but to his readers (in the event of his work being published), by full and accurate illustrations. Very few microscopists are competent draughtsmen, or capable of making drawings of objects under the lens, at all correctly, or even presentable as illustrations thereof. And a drawing thus made is always permeated more or less by the imagination of the artist; so that the greater his skill in that direction the more likely is he to introduce features, not as rendered by the tube, but as he thinks he sees them. To be sure, photographic reproductions of many microscopical objects are in a majority of cases not by any means perfect, or what one could desire, but they are vastly superior to almost any drawings in their accurate delineation of the various features of the specimen. The saving of time is another most important feature, as a dozen negatives may be taken in less time than that required to make a single careful drawing.

In the old "Wet-plate" days, the comparative insensitiveness of which precluded the use of a lamp as the illuminator, only those possessing a well filled pocket-book or having access to the resources of a governmental or college laboratory could avail themselves of the aid of photography in connection with the microscope. But the modern gelatine "Dry-plate" has placed in the hands of every one a cheap and efficient means of doing the highest class of work readily and perfectly. The very highest powers may be used with the light from an ordinary petroleum lamp. I have a print from a negative of *Pleurosigma angulatum* magnified 2,400 diameters, by Spencer's $\frac{1}{10}$ homogeneous objective; the illuminant being an ordinary single wick, coal oil lamp. It is the work of Dr. J. E. Baker, of Wyoming, Ohio, and is fully equal to the best work of Zeiss' Apochromatics, with the highest sources of illumination and every appliance of modern skill and ingenuity, regardless of cost, that have been given to the microscopical world during the past six months.

Why, then, has the use of photography not become more general among microscopists? Simply from the *fancied* difficulties of the necessary but simple manipulations required; and from the *real* one of the absence of any form of camera which could find a regular and permanent home upon the work-table; occupying no more space than the microscope itself, and always ready for immediate use. The latter is a most important requisite. How frequently does the student find in the course of his observations upon living and other tissues, features that are vital toward proving the truth of his researches, but so evanescent that the lapse of even a few minutes may suffice to obliterate

them? If, then, there be at his elbow a small, simple camera which can be at once applied to the microscope without the slightest alteration of the latter, save inclining the body to a horizontal position, using the same source of illumination, be it diffused daylight or that of the ordinary lamp, has he not a boon within his reach, which a few years since would have been deemed impossible? And are not his thanks due to the fellow-worker, whose own wants found expression in the original of the "Handy" photo-micro camera?

My friend, Mr. H. Wingate, of Philadelphia, has long been an ardent worker with the microscope, his studies being almost exclusively confined to the minute fungi belonging to the family of myxogastres. He is exceedingly skilful with the pencil, and his drawings of these minute organisms, their spores, etc., are at least equal to any that have ever come under my observation. But, being actively engaged in business, the time wasted in making these drawings was a large tax, and he determined upon calling in the aid of photography; and there being absolutely no camera in the market to meet his requirements, he proceeded to construct one. Procuring a plate holder of the proper size, he built the camera to suit it, after the plan of the man who carried the bung hole to a cooper shop to have a barrel made for it. His materials were some heavy, blackened cardboard, and an old piece of a steam-fitting some four inches long; his tools, a pocket knife and a glue pot, with the brains to use them. With these crude appliances he produced a camera, adapted to his microscope, and capable of doing the highest class of work. He uses a Zeiss $\frac{1}{8}$ th homogeneous lens constantly; and frequently makes a dozen or more negatives of an evening therewith.

Upon seeing this little affair, I was at once struck with the conviction that if it could be produced in a form adaptable to any microscope, it would fully meet the long-felt want of just such an instrument. The result was the construction of the "Handy" camera, which has already been supplied to many institutions of learning and to private workers.

The camera consists of a mahogany box about $2\frac{5}{8}$ " square, corrugated and blackened on the inside to prevent any reflections of light. A solid cone of some four inches in length, tapering to receive the tube of the microscope, is attached to the front of the box. Preferably, this cone front should be in a bellows form, as in the sample sent, but being rather more costly than the solid cone, many will be satisfied with the latter. In the one case the bellows responds readily to the movements of the microscope tube in focusing; in the other the tube must slide readily into and out of the solid cone. At the opposite end of the box is a groove, in which the plate-holder and frame containing the focusing screen slide. The former carries two plates $2\frac{1}{2}$ " square, amply large for all ordinary illustrations. Should larger-sized pictures be required they can be made by enlarging upon bromide paper.

The focusing screen is made of very thin crystal glass, most carefully ground by hand; presenting the smoothest surface obtainable by this means, but still quite too coarse for the exact focusing of delicately marked objects. In fact the focusing screen is mainly useful in procuring even and full illumination of the field, and in properly centering the object. The final fixing of the exact focus is done by means of a focusing glass used in conjunction with a disk of thin cover-glass at-

tached to the ground surface of the screen by means of Canada balsam.

The camera is mounted upon a stout metal rod, which slides into the upright shaft of a very heavy Japanned base, and can be secured at any height to suit that of the microscope (when the latter is inclined to a horizontal position) by means of a milled head. The base is shod with thick felt cloth, so that it may be placed upon any polished table-top without scratching the latter, and at the same time remain firmly fixed in the position it may be placed in.

And this is all there is of it: Simple, compact, always ready for immediate service, and occupying no appreciable space upon the work-table. Although primarily intended for use with the microscope body inclined to a horizontal position, it may be as readily adapted to the latter in a vertical one, when the character of the objects (as those mounted in fluids) may require. My own method has been to remove the camera from its base and mount it upon the top of an open box containing the microscope. An opening in the top of the box allows the cone to be slipped over the tube of the microscope, and in this manner I have made very successful negatives of blood corpuscles in rouleaux in their own serum; yeast spores in fluid, etc. A correspondent in Boston writes me that he has mounted the camera upon a firm retort stand for the same purpose. Many methods of using the instrument in an upright position will doubtless present themselves to the worker therewith.

The illumination may be effected by reflection from the mirror as in ordinary work, or by removing the latter and placing the lamp behind the stage, and in a direct line with the optic axis. It must be carefully centred in order to illuminate the field alike in all portions. Condensers of various kinds, bull's-eye, achromatic, Abbé, etc., can be used as desired, but with moderate and low powers. The best results will be obtained by the employment of simple diaphragms of various sizes to suit, and so placed as to come close as possible to the under surface of the slide upon which the object is mounted. All extraneous light should be excluded so far as possible, and none be allowed to enter the objective other than the rays which illuminate the specimen. Opaque objects may be photographed quite as successfully as transparent ones, but the time of exposure will be very greatly shortened by employing direct sunlight as the illuminant, if possible.

The eye-piece may be removed or not, as the observer may elect. Following after the teachings and practice of the late Dr. J. J. Woodward, I have almost invariably worked without it, using an amplifier where sufficient magnification could not be obtained with the objective alone. In using medium and high powers, I have not found the eye-piece objectionable, but with low powers, it certainly detracts from sharpness of definition, so that my preference is decidedly in favor of the amplifier, where an increase of power beyond that obtainable with the unaided objective becomes necessary. If possible, however, always use the latter alone. The short tube-length, alone possible (when using the "Handy" camera), renders the employment of amplifier or ocular necessary, if enlargement beyond three or four hundred diameters are to be made, since the limit of a $\frac{1}{18}$ th used direct is less than 350° .

The corrections of most modern objectives as to visual and actinic

foci, are so nearly identical that no difficulty will be experienced in obtaining sharp definition of any subject if a little care be used. But it may not be amiss to say the student's series of Bausch and Lomb are the best, by all odds, of any I have ever seen or used at all approaching them in moderation of cost. I have numerous remarkable examples of their work which I have never seen excelled by lenses of equal powers, no matter what their cost. It certainly is not necessary to go abroad in these latter days to get the best in the optical as well as in many other directions.

The dry plates for the "Handy" camera are furnished by the makers in two degrees of sensitiveness to suit every variety of subject. They are readily developed by any of the methods used for gelatine plates, my own preference being given to hydroquinon or a mixture of that with eikonogen, as giving the clearest results, clearest details, and sharpest contrasts with any desired amount of density. Their cost is but twenty-five cents per dozen; certainly cheap enough to tempt any one to their use.

In conclusion, a few words upon various printing methods. Presuming that every microscopist who ventures into the realms of photography will do his own printing, a few hints may prove useful. There can be no doubt of the beauty and perfection of a good, properly toned, and finished print upon albumenized paper. This is conceded. But comparatively few amateurs will ever succeed perfectly in the operation of sensitizing the paper and toning the print, whilst most of the "ready sensitized" paper on the market is an abomination and a snare. Therefore discard this method of printing, unless prepared to do first-class work.

Passing by platinum as being both expensive and uncertain, excepting in the hands of an expert (although its beauty and perfection cannot be too highly extolled), let us consider for a moment the decided claim of bromide paper, as being the best material for printing in our class of work. Using the smooth surface paper and developing with ferrous oxalate, we get a perfect print rendering the most delicate details with the crispness and clearness of a steel-plate engraving, which indeed it most closely resembles in very many instances. The exposure is made by lamplight, so that one is entirely independent of time or weather, and the finished print is absolutely permanent; as much so, it is reasonable to believe, as a carbon print. If the sheet be allowed to dry spontaneously, it will present the appearance of an ordinary plate engraving. If a polished surface be desired, all that is necessary will be to float the paper, print side down, upon a sheet of polished hard rubber; to squeeze it into optical contact, removing all superfluous moisture, and when quite dry it will peel off the rubber plate with a beautiful polished surface, greatly increasing the delicacy of detail in many subjects, especially diatoms. Most decidedly my preference is given to this form of printing.

But there is another method which, at the risk of being laughed at, I am inclined to gently urge. I refer to the ferro-prussiate, or more commonly named "blue prints." This method of printing is tabooed in many instances, "blue prints" being vigorously proscribed in the albums of the Postal Photographic Club, but for all that it has decided advantages and merits for the work we are considering. It is cheap,

as the paper may be purchased ready sensitized, at very trifling cost, and it requires no skill or experience in the using. It is merely necessary to expose to bright sunlight until sufficiently printed (a few experiments will determine this), and then to wash in several changes of water; the result being a bright, permanent blue print upon a clear, white ground, with excellent detail, excepting in the most delicate structures.

The negatives made with the "Handy" camera are of a convenient size for printing lantern slides by contact. A print on glass is certainly the most perfect of any that possibly can be made, and the importance of this method of demonstration has long since been conceded. Gelatine plates coated on thin glass with special slow emulsions, are furnished by several makers, and any microscopist can readily make his own lantern slides with a little expenditure of time and patience.

On a Mooted Matter in the Use of an Eye-Piece in Photo-Micrography.

By A. CLIFFORD MERCER, M. D.,

SYRACUSE, N. Y.

[Read at the Detroit meeting, American Society of Microscopists, 1890.]

At last year's meeting of this society, the writer opposed the ordinary use of the eye-piece in high power photo-micrography. He held that a sensitive objective nicely adjusted for cover thickness and focussed cannot suffer a change in position without having the nicety of its adjustment to some extent vitiated. The ordinary use of the eye-piece in photo-micrography involves such a change in position, and therefore vitiates to a corresponding degree the resulting image.

Let us see how such a change is so involved. Rays of light leaving a point in an object in focus and entering the microscope pass out of the eye-piece divergent or parallel to enable the normal eye to focus them on the retina. These rays must be divergent or parallel because only such rays are focussed on the retina by a normal eye. Now, as divergent or parallel rays cannot form a real image, the microscope under the foregoing conditions does not project an image on a screen held anywhere above the eye-piece. To get an image above the eye-piece the divergent or parallel rays are in ordinary practice made convergent and, therefore, image-forming by focussing; and it is this procedure which changes the position of the objective.

On the other hand, Dr. Blackham said, in reply, that when an object is in focus for a normal eye looking through the microscope, a plane can be found somewhere above the eye-piece in which a real image of the object is formed. A second focussing is, therefore, unnecessary, and the adjustment of the objective is not disturbed. A few members reported that they had secured photo-micrographs in this plane. Dr. Blackham undertook to demonstrate the formation of the image by means of a solar microscope in an adjoining room. The prescribed conditions seemed to be met, and, apparently, an image was formed on a screen about ten inches from the eye-piece.

Dr. Blackham's demonstration was accepted as satisfactory and conclusive. He was, however, unable to give, when requested, a diagrammatic or theoretical explanation of the formation of the image. Another member had puzzled over the apparent conflict between observation

and theory during two years without finding a solution. The chief purpose of this paper is to record a series of experiments by the repetition of which any sufficiently interested microscopist can satisfy himself that Dr. Blackham's demonstration was in some way at fault, that a real image cannot be formed under the prescribed conditions, and that the failure to theoretically explain the formation of an image under those conditions was a proper and to be expected result.

Experiment 1.—The rulings of a stage micrometer, under an inch and a half objective, were focussed for a normal eye looking through a horizontally arranged microscope. A screen was placed in contact with the eye-piece and slowly removed to a distance of five feet without finding an image in any plane through which it passed. But so soon as the microscope was racked slightly away from the object, a sharp image appeared on the screen, and on again looking through the microscope, the lines seen at first had disappeared.

Experiment 2.—The second experiment was a repetition of the first, excepting that instead of micrometer rulings approximately lying in a single plane, the object was a somewhat thick section of lung tissue. When the object was in focus for a normal eye looking through the microscope, a blurred image could be seen on the screen. On racking the microscope away from the object, the image on the screen became sharp, while the object, as seen through the instrument, lost its sharpness. In the former instance, the sharp focus was found to be on the nearer surface of the object, while the blurred image was of a deeper plane; and in the second instance, *vice versa*.

Experiment 3.—The dust on the cover-glass of a mount, under an inch and a half objective, was focussed for a normal eye looking through the microscope. On removing the head, an image of the object beneath the cover-glass appeared on the screen about ten inches from the eye-piece.

Experiment 4.—A nummulite, under a three-inch objective and two-inch eye-piece, was focussed for a normal eye looking through the microscope. With this arrangement a sensitized plate was exposed at ten inches from the eye-piece. Photo-micrograph 1 is a print from the resulting negative. The result is as good as could be obtained at any distance from the eye-piece under the prescribed conditions. The microscope was then racked away from the object until a sharp image appeared at the ten-inch distance. A second sensitized plate was exposed at ten inches from the eye-piece. Photo-micrograph 2 is a print from the resulting negative.

Experiment 5.—A physician, 68 years old, with presbyopic eyes and long accustomed to the use of a microscope, focussed—without his spectacles—an object as he saw it through the eye-piece. On removing his head, an image of the object appeared on a screen about twenty-seven inches from the eye-piece. A normal eye looking through the microscope could not see the object.

Experiment 6.—An Abbe test-plate, under an inch and a half objective, was focussed for an eye made, as it were, temporarily hypermetropic by wearing a six-inch negative spectacle lens. On removing the head, a sharp image appeared on a screen about ten inches from the eye-piece. The normal eye, without the spectacle lens, could not see the object on again looking through the microscope.

Experiment 7.—Delicate imperfections in the lines of an Abbe test-plate, under a Zeiss $\frac{1}{8}$ -inch objective and a two-inch eye-piece, on a horizontally arranged No. 3 Powell and Leland stand, were focussed for a normal eye looking through the microscope. A sharp, real image could not be seen in any plane within six feet of the eye-piece. A four-drachm weight was carefully placed on the cap of the eye-piece, when a sharp image of the imperfections appeared on the screen about fifteen inches from the eye-piece. On again looking through the microscope, the imperfections of the virtual image had lost their sharpness. The weight acted on the eye end of the microscope tube as on a lever and thus slightly tipped up the objective and increased the distance between it and the object.

Experiment 8.—The dark dots on a light ground of *pleurosigma angulatum*, under a Powell and Leland $\frac{1}{2}$ -inch apochromatic and a one-inch compensating eye-piece, on a horizontally arranged No. 3 Powell and Leland stand, were focussed for a normal eye looking through the microscope. On removing the head, a blurred image appeared on the screen about fifteen inches from the eye-piece, but this blurred image presented the reverse appearance of light dots on a dark ground. A one-drachm weight was carefully placed on the cap of the eye-piece, when a sharp image of the dark dots on a light ground appeared on the screen. On again looking through the microscope, the dark dots had lost their sharpness. By removing the weight, the original conditions were restored. The sharp black dots were once more seen through the microscope, and only blurred white dots on the screen.

Inductions from these experiments are: First, when the microscope is focussed for a normal eye on an object approximately a single plane, the instrument does not project a real image of the object above the eye-piece; and, secondly, when the microscope is so arranged as to project a real image of a very thin object on a screen above the eye-piece, the object is not in focus for a normal eye looking through the instrument. These inductions are in harmony with theoretical optics. Observations really opposed to such inductions must fail to find supporting explanations in theoretical optics.

The announced chief purpose of this paper, to record a series of experiments for particular ends, has been attained. A secondary purpose is to call attention to the fact that the recorded experiments also at least suggest explanations of the apparently opposed phenomena brought to the notice of the society a year ago.

Let us consider Dr. Blackham's apparently contradictory demonstration. The object was a section of animal tissue, showing well injected blood-vessels, and, therefore, necessarily somewhat thick. A normal eye looking through a microscope might focus the nearer surface of such a section, and on removing the head find a real image of a deeper plane projected on a screen above or beyond the eye-piece. In this instance the virtual and real images would be in a general way alike, and might be carelessly considered images of one and the same plane of the object. I believe those of us who were present and had glimpses of Dr. Blackham's virtual and real images were careless in the way suggested.

In regard to the fact that some members had focussed an object looking through the microscope and then without changing the conditions

of the instrument had secured a photo-micrograph of the object beyond the eye-piece, the following suggestions are offered in explanation: The virtual focussing may have been on the nearer surface of the object and the photo-micrograph a picture of a deeper plane; or, the observer's eye may have been presbyopic or otherwise hypermetropic; or, in the case of high-power work in making a connection between the microscope and camera a little weight on the eye end of the microscope tube may have made the necessary alteration in focus; or, a virtual image may have been focussed with an erect tube when the weight of the eye-piece tends to press the objective toward the object and the photo-micrograph secured with a horizontal tube when the weight of the eye-piece tends to tip the objective up and away from the object; or, and finally, in the case of an objective of faulty correction (and Mr. E. Bausch says no ordinary objective would be so faulty) the paths of the visual rays may have been so different from the paths of the actinic rays that the former may have given a virtual image and the latter a real image under the same conditions of the microscope.

Procuring Amœba for the Laboratory.

By C. B. ATWELL,

EVANSTON, ILL.

A simple method of procuring amœba in abundance for the use of classes in biological work, has been used in the laboratory of Northwestern University, and it may prove helpful to others, at least along the Great Lakes, and to those who have been accustomed to consider amœba not readily obtainable.

Instead of following the directions laid down in the hand-books to look for them "in standing water upon the leaves of submerged plants or in the mud and ooze at the bottom," they may often be found upon the algæ of Lake Michigan and presumably of other lakes.

Put a quantity of the common alga, *Cladophora canalicularis* in a tumbler of water. Let it stand on the laboratory table for six or eight days. There will usually be present upon the surface of the mass of *Cladophora* a thin white film or ooze, which teems with amœbæ and other protozoans. The alga mentioned grows along the water-line, where there is the greatest agitation of the water. It can also be relied upon when fresh to furnish *Vorticella*, *Epistylis*, and occasionally a green hydra.

It is frequently possible in the rich supply of amœbæ thus obtained, to observe six, eight, or ten in the field at once. So abundant were they in some material lately examined, that a large number of outline drawings were made of different individuals by a score of students, and micrometric measurements were taken of the rate of locomotion. The average length when pseudopodia were withdrawn, seemed about 25 micromillimeters. A rate of onward progress of one micromillimeter per second was maintained for several minutes in several instances. At the same rate, constantly maintained, the amœba would require 11.5 days to travel the length of a meter.

MEDICAL MICROSCOPY.

By F. BLANCHARD, M. D.,

WASHINGTON, D. C.

Staining Nerve Tissues.—To those engaged in studying the microscopy of nerve tissues we recommend the series of articles running in the *Journal of Nervous and Mental Diseases*, from the pen of Henry S. Upson, M. D. The article in the October number, on Gold Chloride, is particularly valuable. The technical directions are clear, the remarks upon chemical reactions are instructive, and the three photo-micrographs are good.

Malarial Fevers.—*Archives per le Scienze Med.*, vol. xiii., No. 7, contains an article by Golgi in which he claims that the tertian and quartan varieties of malarial fever are caused by two parasites biologically and morphologically different.

The two microbes are said to differ in form and contour, segmentation, degree of motility, period of development, and in their action upon the red blood corpuscle and hæmoglobin.

We wait with interest the confirmation by other observers of these statements.

Invisible Assailants of Health.—Under this title, Samuel Hart, M. D., in the *Popular Science Monthly* for October, makes a successful attempt to popularize some of our present knowledge of pathogenic micro-organisms. Such popular expositions of the rudiments of bacteriology are greatly needed at the present day to dispel the ignorance and incredulity that so often obstruct the laudable efforts of health officers to choke epidemics of contagious diseases. We especially commend it to the perusal of those physicians who “don’t take no stock in microbes.”

Habitat of the Tetanus Germ.—Frequent notes relating to the microbe of tetanus continue to appear in the medical journals all over the world. Whatever may be the ultimate conclusion as to the form, name, etc., of the specific microbe, it seems certain that it lives and multiplies in earth and in the dirt of floors, stables, etc. This is the reason why wounds of the feet are so apt to be followed by tetanus. The wound from a rusty nail produces lock-jaw because the rusty nail carries into the wound dirt mixed with the spores of the specific microbe, and not because there is any pathogenic power of that kind in oxide of iron. The utilitarian application of the fact is that wounds into which dirt has entered should be cleansed and disinfected as speedily and thoroughly as possible.

The Toxic Product of Löfflers’ Bacillus Diphtheriæ.—Brieger and Fränkel have done some good work upon the chemistry and toxicology of this substance. It was obtained from pure pepton broth cultures of the bacillus, in the form of a snow-white, amorphous powder, very poisonous, and producing symptoms similar to those produced by inoculations with the bacillus. In its chemical reactions it closely resembled serum albumen; and an ultimate organic analysis showed a composition closely allied to pepton, with the following percentages: C. 45.35, H. 7.13, N. 16.33, S. 1.39, O. 29.80.—*Four. Am. Med. Association*, Oct. 18, 1890.

NOTES.

Mr. Edward W. Sharp, of Philadelphia, has succeeded in making some very fine slides, showing the mosquito, both male and female. The scales on its legs, body, and wings are very plainly shown with a one-fourth or one-fifth objective. The polariscope can be used to advantage on the body and legs with a one-inch objective.

Mr. H. R. Spencer has severed his connection with the H. R. Spencer Optical Co., of Cleveland, and formed a copartnership with Mr. Fred L. Smith, under the firm name of Spencer and Smith, with an office at No. 515 Rhode Island St., Buffalo, N. Y. Mr. Smith has been a co-laborer with Mr. Spencer in the production of optical instruments during the last eighteen years. They will manufacture a complete line of microscope objectives adapted to all classes of work. They will also manufacture telescopes of all sizes with accessories.

Tariff on Imported Slides.—In a recent letter from Mr. E. C. Hoyt, of Medina, Ohio, he says that in July of last year he had occasion to investigate the subject, and was assured that slides imported for private cabinets and not for sale could be brought in free of duty. The subject comes up at present because certain dealers who have slides to sell have stated that all slides imported for private collections are subject to duty and have seemingly tried to frighten customers with the declaration: "Articles of value forwarded by mail to this country are liable to seizure or penalty, or the customs authorities may, under some circumstances, assess the duty and release the slides."

Mr. Hoyt, who has imported a good many slides, wrote to the collector of customs in Detroit, Mich., inquiring whether he could import for his own collection, and whether he could return such slides as he did not desire and recover any duty that had been paid. Mr. H. C. Christancy, special deputy collector, replied as follows:

"The International Postal Union Convention, or treaty, expressly prohibits the use of the mails for the importation of dutiable merchandise. The microscopic slides, when imported for collections or cabinets for private use, are free. Hence, the treaty prohibition does not apply to them, but when they are brought in for sale they become dutiable, the same as any other merchandise, and then the prohibition of the above treaty operates on them, and hence, customs officers must treat them as they do any other dutiable merchandise, *i. e.*, seize them. As there is no imputation of attempted fraud in such cases, the Treasury Department has authorized collectors of customs to release to the addresses the goods so seized on the payment of a fine equal to the regular duty which would have accrued had the importation been legal; but this authority extends only to the first importation by any one person, and then only when the duty does not exceed twenty-five dollars. It is the only way the Secretary of the Treasury can relieve the owner, as he cannot authorize the collection of money as duty on importation made contrary to law and treaty stipulation, as the highest law. In reply to inquiry whether after paying duty on goods you can secure a rebate on those sent out of the country, I will say this cannot be done, except on the regularly bonding of the goods, and leaving them in the custody of the officers.

"The only way in which you can bring in these goods with any certainty is to ship by express or freight. If you should bring in by mail goods carrying duties of over twenty-five dollars, they would be forfeited. Of course what you bring in for your private use would be free, but an entry and oath would be required if the value was ten dollars or more."

CORRESPONDENCE.

Boston's Supply of Mounts.—This summer I found a fine Tolles $\frac{1}{2}$ -in. objective in Boston. Wishing to test it thoroughly I spent an afternoon hunting good mounted objects. In the city directory were the names of four dealers in microscopes, but two of them had gone out of business, and the other two deal also in spectacles, surgical apparatus, etc. They had a few microscopes, but no slides. At length I found a place where there were twenty-six mounted objects but "not for sale." They consisted of such novel specimens as a fly's wing, human blood, section of wood, etc. I was assured that these were the only slides on exhibition in Boston. An optician on Tremont street said, "There used to be an old fellow who kept such things but since he died he has given up the business." Just think of it: Boston, the hub of arts and sciences, the Athens of America, the cerebrum of the continent, offering to its 450,000 intellectual citizens just twenty-six old dusty microscopical chestnuts.—*Albert Mann, Jr., Newark, N. J.*

[A response will be in order from our friend, William D. Grier, 139 West Concord street, Boston, whose letter-head says, "Microscopic objects in stock and to order."—EDITOR.]

MICROSCOPICAL SOCIETIES.

IRON CITY SOCIETY, PITTSBURGH, PA.

Tuesday, Sept. 9.—At the monthly meeting Mr. C. C. Mellor reported the Detroit meeting of the American Society. A large number of objects were exhibited, including 32 slides from Dr. Thomas Taylor, of Washington, illustrating vegetable and silk fibres. Other slides on exhibition were: *Floscularia*, by Herbert Walker; *Rotifer euchlanis*, By Mr. Henrici; section of the fruit of sweet brier, by Mr. Prentice; section of the cornea of the human eye, by Gordon Ogden, and some miscellaneous slides, by George H. Clapp.

Attention was called to Dr. Fell's paper published in the August number of this *Journal*.

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ST. LOUIS CLUB OF MICROSCOPISTS.

September 10, 1890.—C. C. Farris reported on the examination of some diatomaceous earth from California and presented drawings of the specimens. Wm. Ilardt gave an account of the course of microscopy as taught in Michigan University. M. Noll, of Atchison, Kans., reported that he intended organizing a similar club in Kansas. Dr. J.

C. Falk exhibited a specimen tape-worm mounted in balsam, which he found to be the best medium for such objects. Dr. H. M. Whelpley presented a copy of McDonald's microscopical examination of water and reviewed the work quite favorably. J. B. Whitney resigned as treasurer on account of leaving the city, and Wm. Ilhardt was elected to fill the vacancy.

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WASHINGTON, D. C.—L. M. MOOERS, *Secy.*

Tuesday, Oct. 14, 1890.—The annual election of officers resulted in the choice of the following: President, Dr. Thos. Taylor; vice-president, Dr. C. H. Stowell; corresponding secretary, Dr. J. Melvin Lamb; recording secretary, Mr. L. M. Mooers; treasurer, Mr. J. M. Yznaga; curator, Prof. W. H. Seaman. Dr. Seaman gave a brief account of the Detroit meeting.

SUBSCRIBERS' NOTICES.

[These notices will be given six insertions in this column at 25 cents per line or fraction thereof.
FOR EXCHANGE.—Slides of selected diatoms. D. B. WARD, Poughkeepsie, N. Y.

OFFERED.—Diatomaceous Earth from Utah (Desert) for Histological Mounts.
PROF. ORSON HOWARD, Salt Lake City, Utah.

CORRESPONDENCE invited with a view to the exchange of either mounted or unmounted Oribatida (British) for American species. E. BOSTOCK, Stone, Staffordshire.

WANTED.—Any works on Microscopy not already in my Library.
H. M. WHELPLEY, F. R. M. S., St. Louis, Mo.

First-class Histological Slides for other good mounts; Histological and Pathological material cut on shares.
S. G. SHANKS, M. D., 547 Clinton Ave., Albany, N. Y.

WANTED.—A clean copy of Wolle's *Fresh-Water Algæ of the United States* (2 vols.); also good second-hand Grunow Camera-Lucida, and a self-centering Turn-table.
JOS. P. THOMPSON, P. O. Box 1383, Portland, Me.

FOR SALE CHEAP.—New Gundlach $\frac{1}{18}$ homogeneous-immersion objective, for $\frac{1}{20}$ glycerine or water objective. J. M. ADAMS, Watertown, N. Y.

FOR SALE.—Beautiful photo-micrographs of *P. angulatum*. Only 25 cents each.
J. E. BAKER, M. D., Wyoming, Ohio.

WANTED.—Proceedings Am. Acad. Sciences, XI, 1876. C. W. SMILEY, Washington, D. C.

FOR SALE OR EXCHANGE.—Mosquitoes, male and female. Price 75 cents each. Will exchange only for first-class mounts. E. W. SHARP, 2800 Richmond St., Philadelphia, Pa.

A \$5 MICROSCOPE.—Made on proper scientific principles. Magnifies 100 diameters or 10,000 times. For other interesting articles send for list of Popular Scientific Specialties.
G. S. WOOLMAN, 116 Fulton St., New York.

SPECIAL BARGAIN in histological slides.
WM. N. BEGGS, M. D., 2207 Sidney St., St. Louis, Mo.

FOR SALE OR EXCHANGE.—Photo-micrographs of *P. angulatum* taken through Spencer's $\frac{1}{10}$ H. I., 2400 diameters. Also photo-micrographs of bacteria, diatoms, etc., 25 cents each. Will exchange for well-mounted slides.
DR. J. E. BAKER, Wyoming, Ohio.

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European subscriptions may be sent directly to the above address accompanied by International Postal Order for \$1.15 per annum, or they may be sent to Messrs. Trübner & Co., 57 Ludgate Hill, London, or to Mr. W. P. Collins, 157 Great Portland street, London, accompanied by the yearly price of five shillings.

Microscopy for Amateurs.

By T. CHARTERS WHITE,

QUEKETT CLUB.

[Continued from page 254.]

Section Cutting.—Probably the first desire, which is also more easily gratified, is that of being able to make sections. Tissues to be reduced to sections come under two heads—hard and soft. As each requires a different treatment, it must be dealt with separately; sections of hard tissues being more readily accomplished, command first attention. The hard tissues comprise such substances as bone, teeth, woody shells, like cocoanut shells, the various hard woods, and the stems of plants. There are two methods by which sections of osseous tissues may be obtained; they may be made by sawing off thin slices and grinding them down to the requisite thinness, or they may be soaked for several days in weak acid and water until the lime is dissolved out, when thin sections may be cut with a razor. The former method may be adopted, not only from its simplicity, but because it gives a more correct insight into the histological characters of the bone than is afforded by the softened and dislocated elements of a decalcified section.

Grinding down Sections of Bone and Teeth.—The piece of bone to be cut having been freed from grease in a solution of common washing soda, is cut into slices with a watch-spring saw; in this condition the slice is too thick, and little or nothing of its histological structure can be seen. It may be rubbed down between two plates of ground glass, with the addition of some pumice powder and water, when, by grinding one plate upon the other, the slice of bone between them gets gradually thinner, till, unless the process is continued with great care and frequent examination, the section disappears altogether; as the pieces of ground glass get rubbed smoother by use, it is better, in order to avoid such a mishap, to change the section to older and worn ground glass. It will not be ground down so quickly at this stage, and will be

polished by the smooth glass, which is very desirable. The smoother pieces of glass when wet, allow the process of grinding to be watched very closely and stopped at the right time. There is another advantage in using two plates of ground glass, and that is, in the sides of the section being ground quite parallel throughout the process. It is much cleaner than the methods of grinding usually given in books on microscopical manipulation, and is as applicable to woody shells of fruit and teeth as it is to the osseous tissues. If sections of teeth with the enamel *in situ* are desired, a slight variation must be made from the method just detailed.

Hones of varying degrees of fineness may be obtained at many tool shops. The corundum, an imperfect form of ruby, having its hardness but not its color, is ground fine, incorporated with melted shellac and moulded into hones, files, and wheels. Such a hone is a valuable accessory in this process. Sections of teeth are difficult to make, on account of the excessive hardness of the enamel, a file making no perceptible impression on it if used dry, but if wet with water, a solution of soft soap, or turpentine, it can be worked. But those who attempt to cut it, even by these means, will find the saw, which is usually recommended, but a poor tool against the enamel, and they will break many saws before getting through it to the softer tissue beneath. A lapidary's wheel is the only instrument with which numerous slices of a tooth can be cut, the number being governed by the thickness of the wheel; but teeth can always be rubbed down on one side on a wetted corundum hone, or, what is better, on a corundum wheel attached to a lathe, if it is desired to make only one section. Having ground the tooth down vertically to near its middle, it may be cemented with very little heat to a piece of glass by using very old and hard Canada balsam, and then the other side may be ground down. When ground to the thickness of a card, it may be detached from the glass and further reduced to its final thinness between the plates of ground glass; but this method, while satisfactory so far as the dental tissues are concerned, is apt to leave the edges of the enamel chipped, frayed, and presenting ragged edges. This may be obviated by grinding the section to the middle as before, then polishing the surface very highly with a wet buff leather charged with putty powder. When this surface has received the highest polish it is capable of taking, it may be cemented as before with hard balsam, taking particular care not to heat the glass slide to a greater degree than is sufficient to soften the balsam; for if made too hot, the polished surface of the section will be spoiled, presenting somewhat the appearance of a china plate which has been made too hot in the oven. Having attached the tooth firmly and in closest contact with the slide, leaving a support of the balsam around its edge, grind down the section to the utmost thinness and then highly polish it, as with the previous surface.

There will be, then, only a thin polished section needing to be mounted, a proceeding which requires some care, if the work of hours is to result successfully. Most of these hard tissues, whether of bone, tooth, or nutshell, have an internal structure of great interest, whether viewed with high or low powers. Thus in bone there are the lacunæ, with their exceedingly fine system of ramifications, in teeth the almost similar lacunæ of the cementum, the dentinal tubuli, and the fibres of

the enamel; and it becomes a matter of necessity to mount the sections in such a manner as, while preserving the specimen, will not obliterate the structure. It is found that if a section of either of these substances is put directly into balsam, the air in the internal cells becomes absorbed by the balsam, which, running in to fill the vacuum, reduces the histological detail to the dead level of one uniform transparency, and all evidence of the structure is lost. Means must therefore be adopted by which this disadvantage may be obviated, and two plans are offered, either of which entirely prevents this destruction of detail.

It is obvious that in all structures having internal cells, the fluid media in which they may be mounted will, by endosmosis, run into them, and therefore means must be adopted of keeping this medium out. Thus Canada balsam, used to fasten the tooth to the slide in grinding the section, must not be warmed to any such extent as will liquify it; neither must it be dissolved off in such menstrua as chloroform or benzole, but it may be removed by soaking in absolute alcohol, which, softening the Canada balsam without dissolving it, enables the section to be removed, after which the Canada balsam may be cleared away with a camel's hair pencil. When perfectly clean, it should be transferred to clear distilled water, and allowed to remain until the spirit in the spaces has given place to the water. It may then be carefully dried, and mounted in balsam of a moderate degree of stiffness, when the water in the tubular structure will prevent the balsam running in and obliterating it.

In the effective mounting of bone, teeth, and other similar structures in Canada balsam there are three methods for the occlusion of the minute spaces, lacunæ and canaliculi in bone, and the dentinal tubuli and interglobular spaces in teeth, prior to mounting the sections in balsam.

1. Collodion film answers very well, but is troublesome and sometimes fails.
2. Mucilage film strained, B. P. solution of pale acacia, answers perfectly, but is apt to harbor dust, unless extreme care is taken.
3. The laccic method, coat with an alcoholic solution of white shellac. This is practically the best and simplest method, provided the slide is not heated to more than the melting point of shellac; a mishap not likely to occur.

The finished sections, when ready for mounting, are dipped momentarily in the shellac solution, and withdrawn, when a thin coating of the lac is left over the surface, occluding the spaces but not running in. Instructive sections may be made of many structures which contain loose parts, by allowing them, after dehydrating in absolute alcohol, to soak in a thin solution of balsam in benzole till it has permeated all the parts, when the specimen may be removed and set aside to evaporate and harden; thus corals, teeth in jaws of small mammalia, and the like, may be rubbed down thin without fear of dislocating their integral constituents.

Sections of Echinus spines are among the most interesting objects, but on account of their friable nature difficult to make. This may be almost overcome by soaking the spine in Canada balsam dissolved in benzole, and if it is previously steeped in the benzole, and then placed in the solution of balsam, it runs into the structure, thus supporting it during grinding. This may be greatly facilitated by afterwards placing it in a gentle heat, such as a slow oven, until the balsam becomes hard. There is no difficulty in cutting the section with a fine piercing

saw moistened in spirit. The section may then be rubbed down to the necessary thinness on a hone, the balsam dissolved out in benzole, and the section mounted in the solution of Canada balsam.

Section cutting also includes that of the soft tissues. As it is desirable sometimes to make sections of the hard tissues in conjunction with the soft parts attached to them, and as it is not possible to grind sections in the manner just described, recourse is had to decalcification, by which the lime is removed, and the bony tissues rendered soft enough to be cut with a razor. There are various solutions of acids by which this process is carried out, but the readiest and most efficient agent for this purpose is a saturated solution of common alum to which has been added a few drops of hydrochloric acid to each ounce of solution. While in this mixture the acid dissolves the lime, the alum hardens the soft tissues, so that, in a short time, it is possible to cut very thin sections, showing all the relations between the soft and hard elements of a structure—such sections requiring only very profuse washing to free them from the chemicals before they are ready for staining and mounting. There are other substances from which sections may be made which occupy an intermediate position between the hard and soft tissues, such as hair and cartilage, and it will be desirable to speak of them before describing the preparation of sections from soft tissues.

Hairs are horny cylindrical structures springing from a papilla situated at the end of a tubular depression of the skin, and in investigating their histology, these two structures, viz., the hair and its follicle, should be studied in conjunction. This can be done by sections taken in two directions, and by the use of suitable reagents. There are two methods by which horizontal sections of hair are made, one being to arrange a bundle of hairs longitudinally, and soak it in glue; when this has set the bundle may be cut into thin slices with the microtome, the glue dissolved, and the sections picked out for mounting in Canada balsam. The other plan is to shave the beard very closely with a keen razor, and after a few hours to shave again. In this manner very thin horizontal sections of hair, and a very fair sprinkling of oblique sections may be obtained. Vertical sections through the hair follicle, showing the structure of the root of the hair, may sometimes be purchased; but in many cases the anatomical details are so obliterated in the mounting, that it becomes advisable to make them if we would see the relations of the hair to its follicle and to its surrounding histological elements.

Portions of the scalp, or such other hairy parts of an animal as afford the requisite depth of substance for the follicle, may be cut into small cubic portions, placed in ammonium chromate, and examined from day to day till sufficiently firm to cut into sections. Choose a piece in which the line of section corresponds with the direction of the roots of the hairs. A section may then be produced which will show all we need. Fairly good specimens of the roots of hair may be obtained by slowly drawing out a hair of the beard, which occupies the centre of a pimple. The inflammation and consequent effusion of fluid into the surrounding tissues so loosens the root of the hair that it may be readily detached, bringing with it parts of its sheath and the cells. These preparations should be stained with carmine and mounted in glycerine.

Cartilage is another semi-hard substance which occupies an intermediate position between the hard and soft tissues, requiring no prepa-

ration before cutting. This substance is commonly known under the name of "gristle." A thin section under the microscope shows it to be made up of nucleated cells, distributed through a semi-transparent solid mass. Thin sections of this cartilage are best obtained by free-hand cutting with a razor. In examining these some indifferent fluid should be used, as pure water quickly produces a change in the form of the cells. The fluid which answers well is a solution of one part of chromic acid to six hundred of water. It can be sealed up in this, and will be preserved for an indefinite time.

In cartilage from a shoulder-blade of mutton the cells are irregularly disseminated through the mass; while ossifying cartilage from the joint of a young or fœtal animal commences in the usual manner, but soon an arrangement of the cells in lines coincident with the axis of the long bone is found. The variety found in the mouse's ear resembles chain armor in appearance. To obtain this the ear must be macerated in water till the skin softens by decomposition, when it may be peeled off. In examining cartilage much of its histological detail is lost if the illumination is by direct transmitted light. It is therefore advisable to tilt the mirror slightly in order to modify the intense light.

These are not the only conditions in which cartilage may be found, but are instances of easy examination. It may be found in reptiles and fishes as well as in the mammalia. Once attentively studied it can be readily recognized.

In cutting sections by free-hand, begin upon such vegetable substances as are firm to hold, and yet soft enough to yield very thin sections. The substance to be cut must be held firmly by the fingers and thumb of the left hand, the knuckle of the forefinger being raised as a guide as well as a rest for the razor, by which means the thickness of the slice may be regulated; when the beginner can cut thin and even slices of vegetable tissues by this method, he can hold and cut similar sections of the animal tissues. Many good histologists prefer this mode of cutting sections to using a microtome, and practice seems to make perfect, as far as sections of moderate tenuity are concerned. But no one who has once experienced the convenience of a microtome will care to go through the drudgery of learning to cut sections free-hand.

There are many and various forms of microtome. The principle upon which they are all constructed is either that by which the substance to be cut remains fixed, while the moving razor is lowered by the agency of a screw having a very fine thread, or the substance being raised by infinitesimal degrees by a similar screw, whilst the fixed razor traverses it and slices off the sections. It will, therefore, be seen that the thickness of the sections will depend upon the fineness of the threads of the screw, and the number of degrees it is rotated.

A good instrument for this purpose is known as the freezing microtome, in which the substance to be cut is first saturated with a solution of gum arabic, and then frozen; in cases where it is desired to examine sections from recent tissues without having to put them through the preliminary stages of hardening, it can be employed with great success, and it can also be used for hardened tissue. Therefore it may be recommended for a good, cheap, all-round instrument. It is steady, when, by means of its screw-clamp, it is securely fastened to the work table. A still simpler instrument is held in the hand while the sections are cut.

The thickness of the sections is regulated by a thumb screw at its base. The paraffine plug, containing the embedded material to be cut, is made to protrude from the upper end by the turning of a turn of the screw. The razor is supported on a circular plate, which surrounds the top, and is kept wet with methylated alcohol. An advantage which this instrument supplies is this: if it is desirable to examine the first few sections before proceeding to cut the others, the microtome and its contents may be inverted in spirit and kept moist till it is wanted. It also furnishes a ready means of cutting sections from stems of plants. Hardwood sections are best obtained from the shavings, which may be procured from any cabinet-maker.

In this way, sections sufficiently thin to show the structure well, may be procured. Good longitudinal sections of hardwood, as walnut, teak, mahogany, and cedar, when mounted in Canada balsam, make interesting slides. Fossil woods being silicified, can only be cut by a lapidary's wheel. These and sections of coal which may be placed under the head of vegetable sections, are often purchased from dealers, for coal cutting is dirty work, and troublesome.

The animal tissues in their recent condition are too soft to admit of thin sections being cut. They have therefore to go through a preliminary hardening process. There are various hardening agents with respective capabilities and advantages. One of the readiest is absolute alcohol. Being anhydrous, it soon abstracts all water from a tissue, and hardens it ready for cutting in about twenty-four hours; but its action is so powerful that, while it hardens rapidly, it causes an undue shrinkage, and may mislead our ideas of the nature and histological character of a section. It is better that the tissue should be immersed in a large quantity of some aqueous solution containing chemicals, which has the power of coagulating its albuminous element. There are a number from which to choose. A two to five per cent. solution of bichromate of ammonium, or of potash, used in considerable bulk, compared with the size of the mass of the tissue to be hardened, works as satisfactorily as any. Chromic acid, in strengths of one-fifth per cent. to one-half per cent., may also be recommended; but if all risk of shrinkage is to be avoided, it is better to begin with a weak solution, and gradually increase its strength. Muller's solution is also valuable in many cases.

It is made by adding two and a half parts of bichromate of potash and one part of sulphate of soda to one hundred parts of water; but, unless the student intends extended histological research, the ammonium bichromate will be sufficient.

In whatever manner sections are cut, one thing is necessary, and that is, the possession of a very sharp, hollow-ground razor. Great care must be taken that its keenness is maintained by frequent strapping on a firm flat strap. Sections will be obtained with greater success if it is strapped after every two or three cuts. When finished with for the day, it should be strapped again and put away clean. Many are very careless in this respect. Do not let it get dirty and spotted with rust when it ought to be so smooth that the sections it cuts should slip over its surface freely. If spots of rust are allowed to roughen this surface, the sections will be caught in them and torn.

The next step in section cutting is embedding. The hardened tissue,

cut into blocks of a square form, should have its surface dried with clean blotting paper. If it is the intention to cut it by the free-hand method, proceed as follows: A piece of thin lead foil, or a piece of writing paper, should be rolled around one end of a ruler and the end beaten in to form a sort of round case. A piece of paper, or, what is better, a thin card, may be folded up into an oblong dish of sufficient depth to hold the tissue to be cut, leaving plenty of space around it. Pierce the tissue with a fine needle, and run its point through the paper dish into the table, taking care that by this means the block of tissue is supported in the required position. Then melt some paraffin wax, to which a little lard has been added, and when it becomes fluid, and before getting too hot, pour it into the tray, when it will embed the object to be cut. The embedding mass should, when cold, always bear a relative hardness to the embedded tissues, and it can be modified by the addition of lard, to approximate to the condition of the substance to be cut; or paraffin wax of different melting points and varying hardness can be selected for the purpose. When the mass is hard, it may be placed in spirit till required, the lead foil or paper being previously removed. If a microtome is used, the melted embedding mass may be poured into its well, and while it is soft the tissue is inserted in the desired position and held there till fixed by the cooling of the mass. There are other methods of embedding, such as steeping the object in gum, and afterwards hardening the gum by immersion in spirit. There is also the plan of filling cavernous tissue, such as the lung, with melted cacao butter, before embedding in paraffine.

If the student has practised free-hand section cutting, he may take the mass in his hand, wrapped around with a piece of blotting paper, and, holding it firmly, steadily cut away the mass in thin slices. The razor must be kept well wet with spirit, and be drawn with a decided cut from one side of the tissue to the other; any pause in the cut resulting in an ugly line across the section. At first there may be a difficulty, but after a little practice a clean, sweeping cut will be attained, the section being so thin that every mark on the razor may be seen through it. These thin slices, as they are cut, may be floated into a watch-glass of spirit, where, if sufficiently thin, they may remain awaiting the next process, while the mass may be returned to the spirit until it is wanted again.

After cutting very thin sections with the microtome, a trouble very frequently arises in transferring them from one solution into another, as in staining and clearing, by their doubling up. This may be avoided by using the section lifter. This useful piece of apparatus may be made by bending a narrow band of German silver about half an inch in width, so that its lower end forms a flat blade at a convenient angle for passing it under a section. With it lift the sections out of the different fluids they have to pass through.

Slides Received.—We desire to return thanks to the donor for the following interesting slide: Diatomaceæ: *Arachnoidiscus Ehrenbergi* from Puget Sound, mounted by Mr. A. B. Newman, Fairport, N. Y.

Diatoms: Their Life-History and Their Classification.

BY REV. FRED'K B. CARTER,

MOUNTCLAIR, N. J.

[Read before the Essex County Microscopical Society, November 13, 1890.]

There is no need to plead the cause of the diatoms among microscopists. For almost the first word the tyro heard in connection with the microscope was this word "Diatom;" one of the first slides he ever owned was very likely a slide of diatoms; the first copy of a *Microscopic Journal* that he ever saw doubtless had something to say about them. There may be lovers of the tube who are ignorant of rhizopods or desmids, but there are none who don't know anything about diatoms. The difficulty is just the opposite. They think they know everything about them, and talk so glibly on the subject that one would suppose they were up in it from A to Z. Anywhere you may hear them discussing learnedly the disputed point as to whether the dots on *Angulatum* are elevations or depressions, and asserting that they have resolved *Saxonica*, or *Amphipleura*, or *all but* resolved it, and yet I venture to say that the majority of amateurs know very little about diatoms, and for this reason: because they have confined their attention to the markings on a few typical forms and those the hardest in the series. The amateur has heard that a good glass of a given power ought to resolve this or that species, and so he buys a slide and goes to work at it, and if he can't coax his glass to do what he wants he isn't satisfied until he has gotten hold of one that can; and then he goes for the next harder form, and so on until he reaches *Amphipleura*. Till he can resolve that he is unhappy. And when he has resolved it he spends the rest of his days proudly exhibiting the long-sought objective. As a rule, that satisfies him, and he thinks he knows all there is to be known about diatoms, when as a matter of fact if that is all he knows, he knows next to nothing about the subject. What he does know and all that he knows is how to show minute dots or resolve fine lines, and a Nobert's ruled band, or a podura scale, or the pygidium of the flea, or the finer tracheal tubes of an insect, would have answered for that. I am tempted to hazard the assertion that there are those who can resolve *Amphipleura* who can't tell intelligently where it belongs or give any fair description of it, who know scarcely anything about either the structure or arrangement of these forms which are so familiar to their eye. And therefore while it is unnecessary to urge amateurs to observe them it is entirely in order to plead for a wider view of the subject, and to press them to get some definite idea of the principal points connected with their growth and classification. Let me state the questions then which it seems to me the student ought to be able to answer, and do what I can toward supplying the requisite information.

What is a Diatom?—It is a plant; because it can draw its nourishment directly from the mineral world, and because its mode of growth allies it to the vegetable rather than the animal kingdom.

Where in this vegetable kingdom does it belong?—At the very bottom of the scale. It ranks with the desmids and below the fungi and lichens. It is a cryptogam, and in the second division of the cryptogams, the thallogens, and in the very last division of these. That is to say, it belongs to the simplest class of plants that is known, and it is

among the simplest members of that simplest class. It belongs to the *algæ*, and to the lowest division of them, namely, the one-celled *algæ*. It is a protophyte and ranks as low as a protozoan in the animal scale.

What, then, is its structure?—It is a plant that has neither root, stem, nor leaves; in short, is nothing but a cell which discharges the functions of all three. For though a number of these cells may be united together, yet the diatom is just one of them and no more. *Fragilaria* forms a filament, *Meridion* a spiral, *Licmophora* a fan; but neither the filament nor the spiral nor the fan is the diatom. In each case it is one of the joints or cells and no more that is such. Yet my impression is that there are those who have looked at these forms again and again, who are not aware of that fact. The diatom, strictly speaking, is always the simple cell, no matter how many cells are joined together. And properly one should say of either of the above that it is a number of the genus *Fragilaria*, or *Meridion*, or *Licmophora*.

What are the chief characteristics of this structure?—A hard outside membrane or wall, and a soft internal substance or protoplasm, termed endochrome because of the granular coloring matter which is diffused through it, except perhaps in the centre, which is often occupied by the nucleus. This latter element, the nucleus, is the most vital part and is intimately connected with the reproduction of the plant. Oil globules are also found in the protoplasm. Add to these features bilaterality, for the diatom is composed of two nearly symmetrical pieces and motion. So far the diatom is very like a desmid.

What are its distinguishing characteristics?—First, the presence of silex in the cell wall, the result of which is that the shell remains intact after all the contents have been burned away. Next, the presence of bands or stripes which form along the inner margins of the two valves; and finally, the color which is usually yellowish-brown instead of green, though it is not always so, for the young diatom is sometimes almost, if not quite, as green as a desmid; and this should not be forgotten. It is only in the later stages of growth that the diatoms are always brown.

How do diatoms move?—Find that out and you will make a name for yourself in the scientific world, for nobody knows, though many have tried to solve the problem and imagined they had discovered the key to it.

How do diatoms multiply?—Certainly by subdivision and conjugation. Possibly, also, by the formation of spores, resting spores, or active zoospores. Now, as to the known process of subdivision. Get a couple of pill boxes, one of which is just a trifle larger than the other, and, taking off the covers, place the boxes together, top to top, and one just within the other. Each box represents a valve, and where they are applied the line of junction or suture. That's your diatom cell or frustule, and inside imagine the nucleus and the semi-fluid protoplasm. Now suppose the nucleus to divide and the rest of the contents as well at this line of junction, and each half to form another half like itself, but each of the new halves to be formed inside each of the old halves respectively, and the new halves to push the old ones away from each other, the intermediate space on the cell wall being filled by the growth of two bands at the free ends of the old outer valves. Pull your pill boxes apart therefore a trifle, and fill the intermediate space by two

hoops made by cutting a couple of circles from pill boxes of the same respective sizes as the first two. The original pill boxes are thus still united together by these hoops or bands, one of which encloses the other or rather overlaps it more or less. Imagine this to go on, each of these bands growing wider, and at the same time imagine the new inner valves to grow until they form, respectively, the counterparts of the outer valves. In other words, suppose two pill boxes to have formed inside the original ones and each a trifle smaller than the pill box in which it forms. Now pull your two original pill boxes apart; that is, slide the larger off the smaller, and imagine the inner boxes to meet your eye, each like the outer one in which it has grown except that it is reversed and a trifle smaller, and you have the idea of the method by subdivision. That is to say, a frustule or diatom has two valves joined together, one of which, however, is a trifle larger than and slightly overlaps the other. And in each of these valves a new valve is formed which is a trifle smaller than the one it is formed in and the reverse of it.

Prof. H. L. Smith states, however, that in some genera the connecting membrane of the valve does not overlap that of the other like the cover of a box, but that the two edges of this membrane are in contact and of the same size on each valve. (Proceedings of Amer. Soc. of Microscopists, 1887, pp. 68, 69.) Still he admits that in the greater portion of the diatoms one membrane overlaps the other.

To get the correct idea of the process of subdivision therefore one ought to make himself perfectly familiar with the structure of the diatom frustule, and, I may add, with the growth of Desmids, especially such as *Micrasterias* and *Euastrum*.

Now, as to the first point, the books usually consulted are not as clear as they might be. Thus the *Micrographic* says, "The individual cells of the *diatomaceæ* are called frustules, and are furnished with a coat of silica. * * * This consists of two usually symmetrical portions or valves comparable to those of a bivalve shell, which are in contact at their margins with an intermediate piece (the hoop) variable in breadth according to age. * * * When this is very narrow it forms a mere junction line, and is called the line of suture."

* * * During the process of multiplication by division * * * the narrower or broader band or hoop undergoes an increase of width, and the two valves are removed some distance apart (see pl. xv, figs. 7 and 45.)" Fig. 7 is *Navicula cuspidata*, Fig. 45 is *Stauroneis pulchella*. "Sometimes it consists of two pieces, one overlapping the other." Now, that whole statement is, in my opinion, wrong and misleading. For (1) the hoop is not an intermediate piece between the valves at their margins nor do the examples cited prove it; and (2) it does not sometimes or ever consist of two pieces overlapping each other. In such cases there are two hoops, and not one hoop composed of two pieces; at least this is so in *Triceratium*, *Isthmia*, *Aulacodiscus*, *Biddulphia*, and others, as I can show by slides, and Carpenter states this generally. Moreover, in the plates of the *Micrographic* there are over 200 figures of diatoms and 50 of the front view. But there is not a single figure of them all which shows the student this most important fact respecting the nature of the hoop. Among them are figures of the diatoms mentioned above. In not one of these figures is the drawing correct. In each and every case the diatom is represented as ap-

parently having but one hoop, whereas there are really two, and in no figure is the prime point indicated—namely, that one valve with its hoop or band fits into the opposite valve with its hoop or band. So that the student who relies upon those drawings will never get at the truth.

Nave's Handbook is just as faulty in both text and drawings. Thus he says, "It may help to guide the young botanist if he keeps in mind that the 'sides' are the silicious membranes, which, from their enclosing the contents of the plant, are more appropriately named 'valves,' while the 'front' is the frame or hoop, as it is generally termed, which binds the flinty surfaces together. And then he shows two valves and the hoop by itself, and while this figure is a *Navicula* he uses it to illustrate *Biddulphia* and *Triceratium*. Now, that is not the correct description of either *Biddulphia* or *Triceratium* or even of some species at least of *Navicula*. The student gets the idea that the two valves are held together by a ring which fits over the margins of the valves and which is a piece by itself. But it is not so in the cases mentioned. And many of his figures of the front view are incorrectly drawn, while again in no case is the important point indicated, that one valve fits into the other valve.

Hogg, too, is just as misleading in his figures, and while he says scarcely anything about the hoop or band in the text, what he does say is incorrect.

Carpenter states the matter correctly. He says, "As soon as the valves begin to undergo any increase, they separate from one another; and by the silicification of the cell-membrane thus left exposed, a pair of hoops is formed, each of which is attached by one edge to the adjacent valve while the other edge is free. One of the valves is always older than the other (this, however, I question, for when the frustule comes from a sporangium both valves, unless I am very much mistaken, are of the same age), and the hoop of the older valve partly encloses that of the younger, just as the cover of a pill-box surrounds the upper part of the box itself. As the newly formed cell increases in length, separating the valves from one another, both hoops increase in breadth by additions to their free edges; and the outer hoop slides off the inner one until there is often but a very small overlap (p. 328, 6th edit.) Contrast the description of the process in the *Micrographic*; "the two valves separate from one another, remaining connected by the simultaneous gradual widening of the hoop. The history and ultimate fate of the hoop seems to be variable.

"Perhaps the most remarkable development of the silicified hoop occurs in *Biddulphia*, *Isthmia*, and similar forms; the new half frustules formed inside the hoop of these genera slip out from it like the inner tubes of the outer case of the telescope," which is not so in the case of either *Biddulphia* or *Isthmia*. Carpenter, I say, states the matter correctly. Dr. Wallich had done so before him, and Prof. Hamilton Smith confirmed Dr. Wallich's view. But their articles are not in the hands of the ordinary student. J. D. Cox mentions the two hoops of *Isthmia*, but adds a third which he asserts overlaps them both at the line of junction. Carpenter, however, asserts that there is no such third hoop,* and there can be no doubt that he is right. But while Carpen-

* P. 328, note.

ter is correct in the text, even he is just as much at fault in his figures, probably because he did not draw them himself. For in those figures also there is the same lack; the one important point is not indicated that one valve with its hoop fits into the other valve with its hoop. So that the student will find himself bothered enough if he tries to reconcile the text and the drawings. The president of the N. Y. Mic. Soc. at a meeting on January 7, 1881, also stated the matter correctly, but no drawings are appended to the report of that meeting in the *Micros. Jour.*, and the report is besides in fine print and apt to be overlooked. In fact, I know of only one man who has correctly drawn the valves in front view, and that is Schmidt, in his atlas of the Diatomaceæ. (Since writing the above I have found, however, that Rev. Wm. Smith, H. L. Smith, and Greville have done so.) If the student has access to Schmidt's plates and will look at his figures of *Navicula pachyptera* (No. 5, pl. 45), *Nav. distans* (No. 14, pl. 46), *Nav. northumbrica* (No. 19, pl. 47), and other *Naviculæ* (Nos. 7 and 9, pl. 48), and especially at those of *Aulacodiscus scaber* (No. 6, pl. 33), *Aulacodiscus kittonii* (No. 6, pl. 41), and those of *Triceratium* on pl. 77, he will see the difference between them and the figures in the *Micrographic* or Carpenter at a glance. For in Schmidt's plates, by the uneven edges and by the double line for a part of the edge, it is plainly shown that the one valve with its hoop is enclosed in the other valve with its hoop. Yet even in this atlas the student might readily overlook the fact; for though there are over 1,500 diatoms figured there, among them all there are only about 10 which show this point distinctly; and unless the student is more than commonly observing, or has had his attention called to this matter, it will probably make no impression.

[To be continued.]

List of all Patents for Improving the Microscope issued in the United States from 1853 to 1890.

- 1853. H. De Riomondie. Oscope (No. 9,581).
- 1861. R. P. Dagron. Photo charm (No. 33,031).
- 1862. H. Craig. Charm (No. 34,409).
- 1864. J. Ellis. Seed microscope (No. 42,843).
- 1865. Wales. Plain movable front to lens (No. 46,511).
- 1865. J. J. Bausch (No. 47,382).
- 1865. C. B. Richards. Friction wheels on rack motion (No. 47,860).
- 1866. H. L. Smith. Side reflector above objective (No. 52,901).
- 1866. Heath. Combined microscope, telescope, and eye glass (No. 54,542).
- 1866. R. B. Tolles. Binocular eye-piece (56,125).
- 1866. O. N. Chase. Seed glass (No. 56,178).
- 1869. J. H. Logan. Dissecting microscope (No. 93,895).
- 1874. J. J. Bausch. Botanical microscope (No. 151,746).
- 1876. Wales' pillar fine adjustment (No. 178,391).
- 1876. J. Zentmayer. Fine adjustment carrying rack, swinging sub-stage (No. 181,120).
- 1876. Gundlach. Fine adjustment (No. 182,919).
- 1877. Gundlach. Glass stage, sliding carrier (No. 198,607).
- 1878. R. B. Tolles. Sector illuminator (No. 198,782).

1878. R. B. Tolles. Swinging illumination tube (No. 198,783).
 1878. J. J. Bausch. Convex base to stand (No. 199,015).
 1879. Gundlach. Pillar tube (No. 211,507).
 1879. Gundlach. Eye-piece of field lens and triplet (No. 212,132).
 1879. H. G. Deal. Cloth counter for bolting cloth (No. 214,283).
 1879. W. H. Bulloch. Swinging sub-stage loose from mirror (No. 215,878).
 1879. Gundlach. Triplets as one element of lens combination (No. 222,132).
 1880. W. H. Bulloch. Scroll turn-table (No. 226,648).
 1880. Molera and Cobrian. Binocular (No. 230,320).
 1880. E. Bausch. Folding microscope (No. 230,688).
 1880. J. W. Sidlo. Cog wheel turn-table (No. 235,030).
 1882. Lomb and Bausch. Trichinoscope (No. 251,721).
 1882. P. H. Yawman. Differential screw fine adjustment (No. 262,634).
 1883. Foster. Socket (No. 270,296).
 1883. W. J. McCausland. Magnifier for telegraph (No. 270,907).
 1883. F. B. Gould. Micro-photographs (No. 271,838).
 1883. L. McIntosh. Pin arm (No. 273,752).
 1883. E. Bausch. Electric light and microscope (No. 277,869).
 1883. W. H. Bulloch. Bayonet catch nose-piece (No. 287,904).
 1883. D. Tetlow. Bottle seed microscope (No. 287,978).
 1884. E. Bausch. Swinging Wenham prism (No. 293,217).
 1884. W. K. Kidder. Electric spark device for microscope (No. 295,770).
 1885. E. Bausch. Microtome (No. 325,722).
 1885. E. Bausch. Sheet metal flanges to tubes (No. 328,277).
 1886. G. Fasoldt. Spring nose-piece (No. 334,009).
 1886. G. Klippert. Turn-table (No. 334,530).
 1886. G. W. Palmer. Bevelled slides (No. 336,257).
 1886. B. F. Allen. Stand (No. 352,639).
 1886. E. H. Griffith. Turn-table (No. 354,130).
 1889. S. Frost. Botanical microscope (No. 407,192).

BACTERIOLOGY.

Germicidal action of Blood-serum and other Body Fluids.—

The doctrine of phagocytosis, invented by Metschnikoff, and claiming that bacteria are destroyed by certain cells (phagocytes) has been recently opposed by the conjecture that it is the fluid constituents of the blood which really furnish the destructive agent. Dr. T. M. Prudden has made experiments with two pathogenic bacteria, *B. typhosus* and *Staphylococcus pyogenes aureus*, on blood-serum and other body fluids. The experiments were conducted in the usual manner and with the usual precautions, and as the result thereof it was found that fresh blood-serum possesses, though in different degrees in different animals, and in varying potency with the different bacterial species, a most marked germicidal power; that a similar germicidal power resides in fresh human non-inflammatory transudations. That this power is not directly associated with the formed elements of the blood or transudates, but is in

some way dependent upon their albuminoid constituents. It would furthermore appear that this singular and apparently most significant capacity of the body fluids is ultimately associated with that complex condition which we call life.

The paper is a most excellent summary of the present condition of this question, as well as a record of his own personal experience.—(*Medical Record*, Jan. 25, 1890.)

Bacteria in Milk.—Professor H. W. Conn, in discussing the bacteria of milk, remarks that their function varies with the species, some of them having the property of imparting an agreeable flavor to the butter made from it, while others communicate a disagreeable odor and taste.

From milk and cream the author has isolated forty different species, which, from their effect, are divisible into three classes: (1) some produce no visible effect, the milk remaining apparently unchanged. Some of these, however, render it slightly acid, others slightly alkaline, and nearly all produce certain decomposition odors; (2) another series has the power of breaking up the milk-sugar, producing sufficient acid to curdle the milk. To this belongs *B. acidi lactici*; (3) a third class curdles milk, but the reaction is either alkaline or the reaction is not affected. Such bacteria have the additional function of dissolving the curd which they produce, converting it slowly into peptones, whereby the milk becomes liquid again.

The author then proceeds to discuss the connection between butter and bacteria, the connection being established through cream, in which the growth is longer continued and more prolific. How the action of bacteria on cream results in what is known as “ripening,” by which butter “comes” more easily; secondly, it keeps longer; thirdly, the flavor is improved. The ripening is effected by the action of bacteria, which disintegrates the albumen, partly by production of an acid and partly by a peptonization. The flavor is due to the impregnation of the butter with aromatic principles, the product of decomposition; the difference in taste and odor being due to the action of different bacterial ferments. Hence butter made from sweet cream is flat, insipid, and tasteless, because the bacteria have not had time or opportunity to produce the volatile decomposition products. The author finally discusses the relation of milk-souring to electricity. From a series of experiments made on milk, he finds that electricity has not this effect on milk, and offers in explanation that “thunderstorms” are usually preceded by climatic conditions of temperature and moisture very favorable to bacteria growth. (Associated Dairying Comr., Board of Agriculture Report for 1890.)

BIOLOGICAL NOTES.

By PROF. J. H. PILLSBURY,
NORTHAMPTON, MASS.

Vitality of Vegetal Tissue.—A neighbor brought us, early in the season, a section of a woodbine (*Ampelopsis quinquefolia*) stem which was broken from the vine some time during the summer of 1889, probably in August, a considerable portion of which was still fresh and

green. The leaves have, of course, entirely withered and fallen, the tendrils are dry and hard, as is also a portion of the stem at each end, but in the central portion the bark is green, and, with the wood, has every appearance of being fresh tissue.

Experiments on Hydra, recently conducted by Dr. C. Ischikawa, show that the oft-quoted experiments of inverting the body tube of hydra need to be explained more fully. He finds that the ectoderm cells do not become endoderm cells, but the hydra either resumes its former position or dies. When the body is cut in two, a new mouth is formed by the folding over of the ectoderm cells.

Fresh-water Algæ.—Prof. William West contributes to the June number of the *Journal of the Royal Microscopical Society* an article on the Fresh-water Algæ of North Wales, read by him at the meeting of the Society, April 16, 1890. The paper gives a list of the species found by the author, and not included in the previous list of Mr. A. W. Wills, published in 1881, and such of that list as are found in new localities.

Diatoms.—Mr. Cornelius Onderdonk (*Microscope*, x, 225) has experimented to ascertain the cause of the motion of diatoms. Believing that neither the theory that invisible cilia, not streams of water pouring through the frustule, were the cause of the motion, he stained fresh diatoms with methyl green and found that the frustule was surrounded by a very delicate layer of protoplasm which he calls a mantle, and gives $\frac{1}{80000}$ of an inch as its greatest thickness. The mobility of protoplasm, as manifested in other plants, he thinks sufficient to cause the motion of the diatom, which he says only occurs when the diatom is in contact with some other body heavier than itself, otherwise the object is moved. The diatom giving the best results was *Pinnularia radiosa*.

Pollen.—Prof. Byron D. Halsted has shown (*Microscope*, x, 229) that the pollen of green milkweed (*Asclepias viridiflorum*) can be induced to germinate between sheets of agar agar so thin that the pollen tubes can be studied through the films with low powers of the microscope. The species of the allied genus *Asclepias* give similar results, and the experiments are certainly sufficiently interesting to be often repeated by workers with the microscope.

Cell Nucleus.—Experiments by Dr. B. Hofer (*Jahr. Zeit. f. Nat.*, xxiv, 105) show that the mobility of protoplasm is dependent upon the nucleus of the cell, and that digestive fluids are only secreted by protoplasm in which the nucleus exists, while respiration and the function of the pulsating vacuole are not dependent upon the presence of the nucleus.

Striped Muscular Fibre.—Mr. C. F. Marshall finds that the transverse striæ of voluntary muscular fibres are directly connected with the muscle corpuscles and that this network is connected with the nerve endings.

Ancestry of Insects.—*The Journal of the Royal Micro. Society* quotes E. Haase as urging that the researches of various observers "justifies the supposition that the existing hexapoda are to be derived from polypodous myriapodiform ancestors." These suggestions are based upon facts which we now know in regard to the abdominal legs of the larval stage.

NOTICES OF BOOKS.

The Annals of Tacitus, I-VI. William F. Allen. 8°, 444 pp.
Ginn & Co., Boston. (Price, \$1.65.)

The reputation of Tacitus during his own lifetime both as an historian and an orator was very high; and the stately, earnest style in which his *Annals* are written fully warrants the long and concentrated study which they have received in past years.

Professor Allen's intimate acquaintance with Roman history and the interest which he has felt in the character of Tiberius have given him exceptional qualifications for editing the *Annals*, and the present work is clearly marked with the care and precision of his style.

In editing this volume Prof. Allen took as his basis the text of Halm's fourth edition of Tacitus (Leipsic, 1882). Deviations, however, in the line of a closer adherence to the reading of the manuscript, are noticeable. As a leading aim of the present commentary is to present a connected view of the character and reign of Tiberius, to make the view more complete, the lost portions of the fifth and sixth books have been in a measure supplied by extracts from Dio Cassius, Suetonius, and Juvenal.

The presence of the notes at the foot of the page, together with the supplement of an index to names and an index to notes, add greatly to the value of the volume.

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